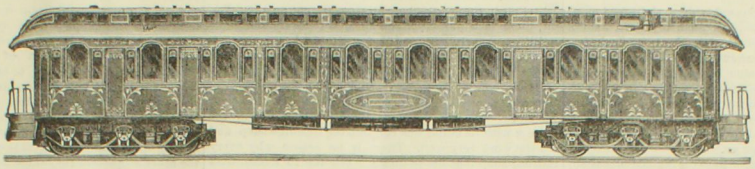
NATIONAL CAR AND LOCOMOTIVE BUILDER.



VOLUME XVIII. NUMBER 6. } JUNE, 1887. { SINGLE NUMBERS, TEN CENTS, $1.00 PER ANNUM.

Miscellaneous Items.

THE Western Railway Club has lost another able, active and hard-working member, by Mr. C. H. Mead leaving the Chicago & Atlantic Railway, at Huntington, Ind., to accept the position of general foreman of the car shops of the Texas Pacific, at Marshall, Texas, under Mr. Jacob Johann.

IT is said that the financial difficulties which caused the suspension of work on the Hudson River Tunnel in the fall of 1882 have been overcome, and that the necessary funds for completing the undertaking have been obtained. No changes have been made in the plans, and it is expected that the work will now be pushed forward as rapidly as possible.

IT is said that immense car and locomotive works are soon to be erected in the vicinity of St. Louis for the construction and repair of all kinds of rolling stock for the entire southwestern railway system. It is the intention of the projectors to build residences for the workmen, a railway city in fact that will be a second Pullman. The plans are said to be completed and that the expenditure will amount to several millions of dollars.

THE Schenectady Locomotive Works have just turned out two mammoth 10-wheel locomotives for the Colorado Midland road. The cylinders are 19 inches in diameter with 24-inch stroke. The drivers are 56 inches in diameter. The engines weigh 57 tons each, and are said to be the largest ever turned out at the works. They are provided with the American steam brake on all the drivers, the Le Chatalier brake on the cylinders and the Westinghouse on wheels of tenders.

A SET of the Dean guides has been in use on the Concord Railroad for four years without any repairs. Those in use on the Old Colony road are also giving the most perfect satisfaction. This form of guide is closed in from the dust and is always clean, so that it can be run at less cost for oil than ordinary exposed guides, besides being less liable to wear, since very little grit gets in to grind it down and put it out of shape. The guide presents a large wearing surface for the upward pressure of the crosshead, is very stiff and yet lighter than a set of common guides, all good recommendations that ought to appeal to master mechanics.

THE Dublin United Tramways Co. have built a new two horse car for the Manchester Jubilee Exhibition. It is 14 ft. 9 in. long and carries 21 passengers inside and 20 outside. The framework of the car is composed of Irish ash and oak, the outside paneling of rare specimens of figured mahogany, and the inside panels of figured pitch pine relieved by hand-made walnut moldings. No paint is used on the inside woodwork. The seats are covered with tapestry carpet, and the metallic fittings are nickel-plated. All manufactured materials used in the construction are of Irish make, except the glass, sheet steel and bar iron.

MR. ROBERT COLVILLE, master mechanic of the Chicago, Burlington & Quincy Railroad, at Galesburg, Ill., has been experimenting with single nozzles for locomotives having the extension front and high exhaust pipe, with very great success. His first experience in this line was with an engine of the eight-wheel type, with cylinders 17 × 24 and the standard boiler. He first tried a nozzle 4½ inches diameter and found that the engine did not steam any too freely. Instead of closing up the nozzle he began experimenting with the deflector over the flues, and having got that of the proper size and in the correct position, the engine steamed very freely, so freely, indeed, that he was induced, step by step, to increase the size of nozzle to 5½ inches. When he reached this point he found that the nozzle was too large. It was then reduced to 5¼ inches diameter, and the engine is now running with that nozzle very successfully and steaming freely. The engine has a very soft exhaust, throws no sparks, and is noted for light fuel consumption.

STREET CARS, when first introduced in India were unpopular; no one would ride in them, and for this reason. There are fourteen kinds of people, each with a distinctive social caste, and they hate each other like sin. Gradually the great saving of time and walking effected by the cars dawned on their minds, and led them to stifle their prejudices, so far as riding is concerned. The company appealed to their cupidity by running a lottery as well as street cars. Conductors were given little tickets with stubs, and were required to hand one to each passenger. Every ticket was numbered, and informed the owner that on the first of the month there would be a drawing with prizes. This brought passengers to the cars, and has done more to harmonize the population than thousands of missionaries could have accomplished. The lottery is of advantage in another way. It prevents the conductors and drivers from robbing the company. Every ticket is of value to the holder, and the passengers demand them. They afford the best of records of the number of fares taken in.

THERE is an order on the Chicago, Burlington & Quincy Railroad, forbidding engineers from indulging in the practice of using kerosene or other highly volatile oils for cleaning piston packing. Engineers on many roads are in the habit of running some kerosene through their cylinders occasionally, and there is little doubt that it loosens the gummy substance that accumulates on pistons and about packing. A startling accident on the Q. brought out the order forbidding the use of kerosene for this purpose. An engineer had left his train, and was running to the roundhouse, when it occurred to him that he might make a good finish of his week's work by passing a dose of kerosene through the cylinders. Just after the liquid was put in an open switch was seen ahead and the engineer reversed his engine. After the engine made a few revolutions one of the cylinders exploded like a charged shell. The philosophy of the accident was that the kerosene gives off an explosive gas which got intensely compressed by the reversing of the engine, and heat generated by mechanical action supplied the spark which exploded the gas.

The Legislature of Alabama has passed a law requiring all engineers running locomotives in that State to pass an examination and procure a license from a board of examiners appointed for the purpose, the engineers in the meantime being taxed for the costs. The law also holds engineers responsible for damage to persons or property caused by their carelessness. The law is throughout of that mean character ready to be passed by small cliques of narrow gauge politicians in most every State, petty log-rolling or personal benefit being the end sought. There are many abuses connected with railroad and other corporation management which it is right and proper for legislation to check, but locomotive engines on the various railroads are run so successfully and managed so carefully, not only for railroad interests, but for public interests as well, that no good can come of interference by politicians. There is no kind of machinery in use that is better run or more intelligently handled than locomotives, and to make a change in the selection of engineers is to risk making an expensive and hazardous mistake. Putting the responsibility of selecting the men upon a board of politicians will tend to reduce the sense of responsibility ordinarily held by railroad officers in the appointment of men to the important position of locomotive engineer, and the public will be the sufferers.

THE longest street car line in the world is in Argentine Republic, South America, and it will also be the only line in the world to run sleeping cars for the accommodation of its patrons. The road has 200 miles of track, connecting a number of towns in the vicinity of Buenos Ayres, and its equipment has been supplied by a Philadelphia car company. Horses are used as motive power instead of steam, because fuel is dear, horses cheap, and the people are slow. Two tons of coal will buy a horse and harness. The sleeping cars are a curiosity. They are 4 in number, 18 ft. in length, and are furnished with 4 berths each, which are made to roll up when not in use. The cars are furnished with lavatories, water-coolers, linen presses and other conveniences, and are finished throughout with mahogany. The other cars are 4 double-decked open cars, 20 platform cars, 20 gondola cars, 6 refrigerator cars, 4 poultry cars, furnished with coops, 8 cattle cars, 2 derrick cars for lifting heavy material, and 200 box cars. They are ready for shipment in a few days.—*American Manufacturer.*

Engineering and Shop Notes.

CHICAGO, ROCK ISLAND & PACIFIC SHOPS.

Mr. B. K. Verbryck is extremely busy in the car shops at Chicago, mostly with repair work. The extensions of this road in Kansas call for a great deal of finished material that has to be prepared in the Chicago shops, and this adds much work to car and machine shops. Mr. Verbryck is building three new passenger coaches of his standard pattern and rebuilding one chair car for his own road. The latter car will be almost new and will look quite as well as new. It will be equipped with the Scarritt car chair, which is finding favor with this road. The working of the well-abused Interstate law appears to send more passengers than formerly into the day coaches, travelers that used to patronize sleepers now contenting themselves with the accommodations of common cars, and there is considerable talk among Western railroad companies of adding to the comfort of the traveling public by a more liberal introduction of improved seats.

In addition to the new work for his own road Mr. Verbryck is building six passenger cars, also of their standard, for the St. Joseph & Iowa Railway, also six way cars for the same road. The work turned out of these shops is first-class in material and workmanship, and is highly creditable to the road and to the officers in charge. They have excellent shops, well arranged for doing work economically, and the planing mill is reputed among the railroad men best able to judge to be the finest equipped with machinery of any planing mill in the West. Mr. Verbryck is a very successful master car-builder, and he received an excellent training to fit him for superintending car building operations. He learned the cabinet-making and coach-building trade on the Erie, and continued working as a journeyman on the same road after his apprenticeship was finished. During an unusually depressed season, when wages of mechanics were very low, he received an offer to go teaching school and accepted. He remained teaching for a year or two, and Mr. Verbryck attributes a considerable share of his success in after life to the training he had to give himself while teaching school.

Returning to the Erie, Mr. Verbryck went again to work at his trade, but shortly afterwards was put to keeping books in connection with the car department, and acting as an inspecting foreman. While doing this, he kept the record of the building of a car platform that afterwards acted an important part in a celebrated law suit. This platform was designed and built by Mr. C. A. Smith, who was then master car-builder of the Erie. The same pattern was afterward patented as the Miller platform. In the suit that the Miller heirs brought against the Pennsylvania Railroad, to compel the payment of royalty for using the platform, the books that Mr. Verbryck kept were produced as important evidence that the invention was not new, and the patentee's heirs lost the suit.

Mr. Verbryck was for several years general foreman with Mr. C. A. Smith, and from that position was appointed to his present place in 1872.

In the locomotive shops, Mr. T. B. Twombly, general master mechanic, is building seven new eight-wheel locomotives for freight service. Each engine will weigh 42 tons. The cylinders are 18 × 24 inches, wheel centres 57½ inches, shell of boiler 56 inches diameter at smallest ring, with 184 2-inch flues. The boiler is straight and the firebox crown is arched and fastened to the shell by radial stay bolts. This plan of securing the crown sheet by radial stays has been used very successfully on Chicago, Rock Island & Pacific Railway locomotives. In conversation with Mr. Twombly, I learned that he had no intention of changing his wheel centres to conform to the master mechanics' standard. The adoption of that standard has come round too late for him. The road has so many engines with the wheel centres of a size different from anything established by the master mechanics' association, that it would be too expensive to make a change. They have no difficulty in getting their orders filled promptly with the sizes they are using.

I noted some changes on the design of the engines that are now in course of construction. Mr. Twombly has been in the habit of placing the rocker in front of the guide yoke, presumably for the purpose of getting a long eccentric rod. In these engines the rocker is put behind the yoke, a change made necessary by a different arrangement of the guides. They have done away with the col-

lar that is usually put between the main rod and side rod connections on the main crank pins, and make the brass thicker to fill the space. The change is reputed to work well.

All the engines have balanced valves, sight-feed cups, Eames vacuum driver brakes, Friedman injectors, Ashton blow-back valves and connections, short smoke-boxes, diamond stacks and low exhaust nozzles. Mr. Twombly has no use for the extension front, and all his foremen and engineers appear to coincide in his views in this matter. Self-dumping ash-pans have been used a good deal on the Chicago, Rock Island & Pacific locomotives, but Mr. Twombly has now made up his mind that they are a disadvantage, and they must go.

They are getting several new tools for the machine shop, a large milling machine being the principal one. They are arranging to put in a transfer-table alongside of the machine shop, to be operated by power transmitted by a wire rope. Preparations are being made to introduce a hydraulic riveting machine into the boiler shop. Like the car shops, the locomotive shops are getting a great deal of work to do for the Kansas extension.

CHICAGO, BURLINGTON & QUINCY SHOPS AT WEST BURLINGTON.

The main manufacturing shops of the Chicago, Burlington & Quincy system, which embraces some 5,000 miles of track, and owns over 800 locomotives and 30,000 cars, are located at West Burlington on a fine stretch of upland country overlooking the flat valley that formed the ancient bed of the Mississippi, and is still in great part the resort of the river when the Father of Waters rises in its might. The location is excellent for good drainage, fresh air, and room to spread out without being curtailed by valuable property or ground unsuitable for tracks or buildings. The buildings are grouped very compactly in a space that is roughly square, and each shop is easily approached by tracks. The arrangement of the shops is rather peculiar. The main building in regard to size is the machine and erecting shop, which is 316 × 125 feet, and stands parallel with the main track. About 50 feet west of this, on the same line, is the blacksmith and boiler shop, a building 200 × 125 feet. These shops are reached by tracks which traverse them lengthwise, and by others outside running in the same direction. The car shops and paint shop are set at right angles to the other shops, and are reached by means of transfer tables operated by power transmitted through wire cables. The buildings are all of brick, and are so arranged that extensions can be made on the same general plan. Between the machine shop and the main track there is a fine building, 301 × 56 feet, devoted to offices and storehouses. The storage is unusually ample, and there are very few finished articles found lying around outside, a circumstance which is quite exceptional about large railroad shops.

THE MACHINE SHOP.

As usual in such establishments, the machine shop and locomotive erecting shop are under one roof, but the general arrangement is different from what is found in any other railroad shop in the United States. The tools occupy one side of the shop, and the locomotives undergoing repairs the other side. But instead of being placed in stalls or short tracks set across the shop, the engines are set on tracks running lengthwise. Three tracks are used for this purpose, and when an engine is ready for firing up, she is taken up by a pair of overhead cranes and carried between the tracks to the end of the shop. This is a common arrangement abroad and works well. Mr. Joel West, master mechanic, in charge of the shops, is full of admiration of the arrangement, and believes that work can be handled in this shop rather more easily than in any other shop in America. The overhead cranes are used to do all heavy lifting required in the erecting shop. Each has a capacity of 25 tons, but their great margin of power does not unfit them from raising light weights under perfect control, although watching one of these ponderous machines gingerly picking up a sand box, makes the spectator think of an elephant being led out to lift a pin.

Under the erecting shop and machine shop there are finely-built cellars, where vats are kept for cleaning the parts of engines, and the pieces not needing repairs are stored here till the engine they belong to is ready for them. All tools belonging to engines are also stored here. The place is good for storage and cleaning, as it keeps out of the way the miscellaneous collection of articles generally piled up beside engines in the repair shop. It might, however, offer the disadvantage of being a convenient lounging place for the chronically tired man, who is well represented in every workshop.

The tools in the machine shop are particularly well arranged for facilitating work and getting it out systematically. A standard truck traverses the middle of this portion of the shop, and a middle rail is the lower path of a traveling jib crane (Yale & Towne make), operated by power which works through the whole length of the shop, and swings eight feet to either side. All the heavy tools are grouped along side the middle track, so that the jib crane can be used to lift the work. Heavy material can be run in on flat cars and laid down beside the tools, or put directly into a lathe, planer, slotter or other tool. It is found that this traveling crane does the work of about twenty laborers, and does it in much shorter time. Tools have not to stand idle half the time they used to do, when a heavy piece of work had to be put in by hand. While speaking about the convenience of this traveling jib crane, it might be a good time to mention the merits of another crane that is found to be a very useful aid to work here. At the wheel-pit in the yard where all tires are put on and taken off, there is a jib crane set on a flat car for doing the hoisting. When not needed for tire work, this crane is moved all over the yard where heavy weights have to be lifted, and I received enthusiastic testimony of the convenience and time-saving properties of the arrangement. In one case when the traveling jib crane in the machine shop broke down, the flat car with its crane was run into the machine shop and did the work very well. There is no reason why every railroad shop that has to do the work for 10 locomotives and 300 cars should not enjoy the convenience, safety and time-saving resulting from the use of a crane of this kind that costs so little money. The backwoods training of their forefathers has always made Americans prone to handle heavy weights by the crudest kind of contrivances, but this idiosyncrasy becomes very expensive when it is carried into machine-shop practice.

A sensible arrangement about this shop is, that the heaviest tools, such as wheel lathes, large planers, etc., are placed near the end of the shop where material is run in from the yard. They have a very fine supply of all kinds of machine tools, but they are still getting more, several milling machines and a frame slotting machine being expected soon. The tool room is placed in the middle of the shop, which saves a good deal of walking compared to what is necessary where the tool room is located as usual at the end of the shop.

The pits in the erecting shop are provided with water and steam pipes, with valves located at convenient points for filling and testing boilers. The floor of the shop has openings at convenient points, through which the material taken to the cellar for cleaning and storage can be passed in and out. The shop has an iron truss roof, and is well lighted by the roof and sides. Along the outside walls of both machine and erecting shops are arranged neat and convenient work benches, with cast-iron standards properly shaped for holding steam radiators on the back portion.

The greater part of the work the shops are now engaged on is in the line of repairs, but they have also some new work on hand. The erecting shop has a capacity of eight engines for each of the three tracks, but there are only sixteen engines in at present. They are building five consolidation engines with cylinders 20×24 for themselves, five 18×24 six wheel switchers and four 18×24 eight-wheel engines. They have just completed an order for six 18×24 eight-wheel engines for the Burlington & Missouri River road.

In looking round the shop, I noticed that this road adheres pretty closely to the diamond stack and its form of draft appliances. All the engines have hollow stay-bolts, and their effect on combustion is considered beneficial. Jerome packing is used for pistons and valve stems. They are making a great many balanced valves that are open on the top, the steam-chest cover forming the cover for the valve also. They are putting in a good many reverse lever quadrants, with notches cut like gearing to a pitch of ½-inch. The latch is cut in the same way and has fine teeth. All the domes are reinforced by a strong, wide wrought-iron ring that is forged in a former. They use a small engine, placed on a hand-truck, to good advantage for moving into any part of the shop, and supplying power for boring cylinders, drilling stay-bolts and similar work.

BLACKSMITH AND BOILER SHOP.

These two shops are under the same roof, but are divided by a brick wall, which does not, however, keep the smoke of the blacksmiths' fires out of the boiler shop or the noise of the boiler makers' operations from reaching the blacksmiths. Both sides speak disparagingly of the other, and say they ought to be sent elsewhere. Nearly all other mechanics despise having boiler makers working near them, and it is not surprising. The worst combination I have ever seen about a railroad shop, was a boiler shop and paint shop under the same roof, with merely a wooden partition between them. The painters came actually to hate the boiler makers, and all the boiler makers pretended that their health was suffering from the smell of the paint.

This blacksmith shop contains the best assortment of formers and dies that I have seen west of Renovo. A curious piece of forging done here is forming I section of side rods out of a thick bar of solid steel 48×8×3½ inches. They have two heavy cast-iron dies with matrices formed the shape of the I section. One die is attached to the steam hammer and the other is laid on the anvil. Each die has two matrices, one for roughing to shape, the other for finishing. It makes a good job. Nearly all standard pieces of wrought-iron work about engines and cars are forged by the aid of formers and dies, and some of the operations are wonderfully quick and perfect. The shop is well provided with steam hammers, and they are putting in a new additional boiler to receive the heat from the furnace used for slabing work. They forge all their driving axles from old car axles and get very satisfactory results in service, breakage of driving axles being extremely rare on the system.

The boiler shop is about the best equipped with conveniences for doing work of any railroad shop I have ever seen. The shop is bisected lengthwise by a standard track. On one side of this track all the riveting is done, and it is traversed by an Allen pneumatic riveting machine, which is carried on overhead ways. The compressed air, supplied by an Allen pumping machine, is carried throughout the shop by iron pipes, and a strong hose leads the supply to the machine. The riveting is done by light blows delivered with great rapidity, and resembles the action of hand riveting. The work looks well, and is said to be excellent. All work in this shop is laid out to templates, and it is done so well that sheets of fire-boxes, boilers and tanks are said to interchange perfectly. They are so much pushed with work that two more riveting machines have been ordered, one having quick hammering action, with a 72-inch reach, the other a squeezer for bridge work.

Among the power tools used in the shop are a set of rolls 10 feet 6 inches long, two vertical and one horizontal punch, the former two being shears also. A bolt-header, three screw-cutting machines, four drill presses, one gang drill press, a revolving flue welder, a flue cutting machine, and several other machines that are not exclusively employed for boiler-making purposes. I noticed that all scrap-iron was worked up into washers, and it was a very small piece that could not be utilized for a washer of some size.

The machinery of all the works is run by a double-cylinder Corliss engine. Steam is supplied for all power and heating purposes by four Babcock & Wilcox boilers. The greater part of the exhaust steam from the engines is used for heating and lumber-drying purposes.

Most of the railroad men who attended the brake tests visited the shops, and all were highly pleased with what they saw, and everywhere they could not fail to observe evidence of care and able management.

They are working a little over 700 men all told. In my opinion the West Burlington shops dispute the palm with Bloomington for being the best arranged railroad repair shops in the United States. A. S.

The Brake Tests at Burlington.

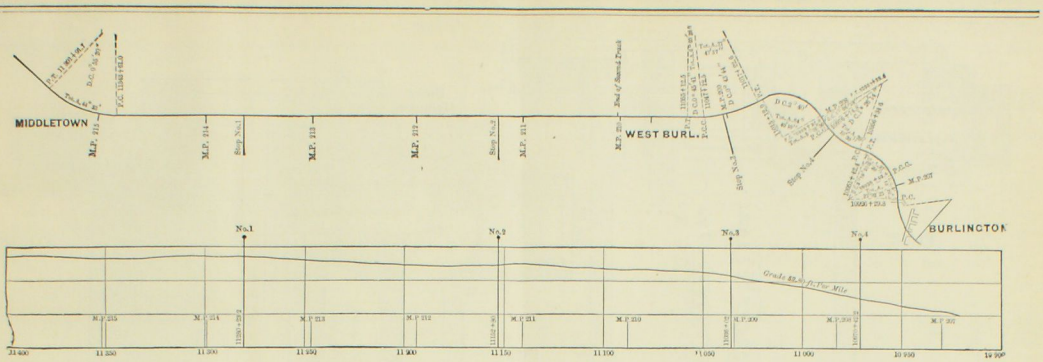
PRELIMINARIES THAT LED TO THE TESTS.

For a number of years, far seeing railroad managers and thoughtful officers of our railroad mechanical departments have recognized the need for an efficient power brake for freight trains. The active movement towards investigating the subject of power brakes for freight cars may be said to have commenced in the Master Car-Builders' convention held in Chicago in 1883, when a committee was appointed to report on the subject the following year. The report submitted at the Saratoga Convention signed by B. C. McCarty and Charles Blackwell did not present a very hopeful view of the subject. Only 18 answers were received to questions sent out by the committee. The most important sentences in the report are the following:

"The advantages to be derived from the use of automatic brakes on freight cars appear very great, but it is possible that they may be counterbalanced by serious disadvantages; for were all freight cars equipped with an automatic brake, the failures peculiar to this particular brake would be, doubtless, encountered to a very much greater extent, and, at least, in the ratio that the number of cars in a freight train exceeds that of a passenger train. The additional cost of application and maintenance of automatic brakes and their incidental failures, might not be objected to if applied to special cars on roads where trains composed entirely of such cars could be run."

Previous to this, buffer brakes were looked to by a great many railroad men as the coming type of power brake for freight service, but Mr. E. B. Wall at this meeting moved, "that it is the sense of this Association, that none of the freight train brakes so far brought to its notice, which derive their power through the compression of the draft springs, fulfills the requirements of a good train brake." The resolution was carried by a vote of twenty to eleven. A new committee, consisting of G. W. Rhodes, George Hackney and B. Welch, was then appointed to continue the investigation of automatic freight car brakes. At the following convention this committee reported progress but made no specific recommendations, and the members were continued without change. They were making progress slowly and their intention was to carry out a series of accurate practical tests, to demonstrate the value of various forms of freight car brakes, but many obstacles arose to delay the projected trials, and when the convention of 1886 came round, Mr. Rhodes, chairman of the committee, reported that they had found it impossible to carry out the tests before the convention met. But they had arranged to make very thorough tests at Burlington, Ia., begining July 13. The tests were to consist of three series of trials. The first to record how each brake while new acted in stopping trains under similar conditions. The second, an endurance test to show how each brake would stand the conditions of regular service. The third, to show how the brakes worked after being worn in service.

The time for these tests duly came round, five brake companies entered the competition, one air, one vacuum, one friction and two buffer brakes. The result was a series of surprises all round. Railroad men and the most experienced brake companies discovered that they knew very little respecting the action of power brakes on 50-car trains, but all who were present learned a good many new things about brakes before the trials were completed. The leading facts deduced from the tests were, that buffer



LINE AND PROFILE OF BURLINGTON BRAKE COURSE.

and friction brakes were very unreliable for handling long trains, and that the air and vacuum brakes tried were too slow in action to stop long trains suddenly without severe shocks.

When the trials were finished, the committee decided that instead of putting the trains of the contestants into the endurance test, it would be better to give the opportunity for effecting the improvements suggested by the experience of the trials, and repeat the tests in April of this year, a date that was subsequently changed to May 9.

AT BURLINGTON.

On the appointed day there were present ready for the competition four automatic brakes, viz.: the Westinghouse, Eames, Carpenter and Hanscom. The Card brake arrived a week later. The members of the committee in attendance were G. W. Rhodes, Benjamin Welch, John S. Lentz and D. H. Neale, the last three members having been added to the committee since the last convention.

The committee published an elaborate and most carefully prepared set of rules governing the tests, which were calculated to give every competitor a fair opportunity to display the merits of his apparatus and to do equal justice all round. The following are the tests arranged, and the intention was to go through them in regular order.

GENERAL TESTS.

(1) 50 empty car train over the course prescribed, making four emergency stops.
No. 1 stops, on level, 20 miles per hour.
No. 2 stops, on level, 40 miles per hour.
No. 3 stops, 53 feet grade, 20 miles per hour.
No. 4 stops, 53 feet grade, 40 miles per hour.
(2) 50 mixed car train, ⅔ of the cars to be loaded to their full capacity and ⅓ to be empty; 75 per cent of the latter to be in the front half of the train; four emergency stops.
No. 1 stop, on level, 20 miles per hour.
No. 2 stop, on level, 30 miles per hour.
No. 3 stop, 53 feet grade, 20 miles per hour.
No. 4 stop, 53 feet grade, 30 miles per hour.
(3) 50 mixed car train, with hand brakes and engine and tender automatic brakes; four emergency stops.
No. 1 stop, on level, 20 miles per hour.
No. 2 stop, on level, 30 miles per hour.
No. 3 stop, 53 feet grade, 20 miles per hour.
No. 4 stop, 53 feet grade, 30 miles per hour.
(4) The 50 mixed car train to be let down a grade of 53 feet per mile, 3 miles long. Speed of 20 miles per hour at the top of the grade, to be reduced to 15 miles per hour as soon as practicable, and maintained without material variation all the way down the grade.
(5) 50 mixed car train once over the course. Brake-shoes to have a slack of from ½ inch to ¾ inch each; four emergency stops.
No. 1, on level, 20 miles per hour.
No. 2, on level, 30 miles per hour.
No. 3, 53 feet grade, 20 miles per hour.
No. 4, 53 feet grade, 30 miles per hour.

SPECIAL TESTS.

(6) 50 mixed car trains; tests to be made on level. Trains to be broken in two or more unequal parts. After trains are broken any assistance necessary shall be rendered by the brakeman, who will be riding on the rear of the train or on the engine when the breakaway occurs.
No. 1 breakaway, on level, 20 miles per hour.
No. 2 breakaway, on level, 30 miles per hour.
(7) 50 mixed car train. Train resistance test:
1. To pass No. 1 stop-post at 20 miles per hour, letting the train drift till it stops, no brakes being applied.
2. To pass No. 3 stop-post at 5 miles per hour, letting the train drift until No. 4 post is reached, at which point the accelerated speed shall be recorded and the train stopped.

A recording apparatus, to be placed in the middle of the train, had not arrived when the committee were ready to begin the tests, and, consequently, the stops described under No. 3 were proceeded with first because they could be carried out without the use of the recording apparatus.

THE COURSE.

All the test runs were made from Middletown towards Burlington. A careful examination of the course, as seen in the accompanying diagram, will show that it is admirably adapted for making tests of this character. On the first part of the run there are six miles of nearly level track, succeeded by two miles of a descending grade 53 feet to the mile. Stop posts 1 and 2 are on the level, and stops 3 and 4 are on the descending grade. The whole course within the range of permissible stops is staked off at short intervals with numbered pegs, which make measurement easy. The C., B. & Q. railroad machine shops are located near the middle of the course, and the good and prompt means of effecting repairs thus provided saved a great deal of valuable time.

THE TRAINS.

Each train consisted of 50 cars and the dynamometer car. This car contained complete recording mechanism, which made an automatic record of the speed, also of the time and distance occupied in making each stop. The car was in charge of F. W. Sargeant, engineer of tests of the C., B. & Q., and he was assisted by W. W. Nichols, assistant engineer of tests, and E. J. Carroll, of the same road, and E. P. Lord, assistant engineer of tests of the Pennsylvania. The dynamometer record was checked by a measurement made from the stop-post to the cab window of the engine. This was generally done by Mr. Lord, and his agility in rushing from cab to post, tape line in hand, and then over the moving train to reach the dynamometer car, was the envy and admiration of all beholders.

In the middle car was a recording apparatus which indicated the speed and recorded the tension on the brake rod. This car was under the charge of Wm. Forsyth, mechanical engineer of the C., B. & Q., and was assisted by W. H. Peirce, of the same road.

The rear car was equipped with a telephone for communicating with the engine, and a slidometer, or gauge, for recording the impact of the train in stopping. In this car the time it took to release the brakes after a stop was kept. The telephone and time records were attended to by R. Ryan and E. W. Penfield, of the C., B. & Q. A. H. Bowman, electrician of the Lehigh Valley, and W. A. Nettleton, brake inspector of the K. C., Ft. S. & G., had charge of the slidometer. This was an exciting position occasionally; but the incumbents stuck to their record, if they often failed to keep their feet.

Each locomotive was equipped with a speed recorder, to enable the engineer to regulate the speed to suit the conditions of each test. R. H. Bayley, of the P., C. & St. L., rode on the engine as representative of the committee. His duty was to signal the engineer when to begin making a stop, see that no sand was used in making a stop, and to record the speed and the pressure indicated by steam and air gauges. He was assisted by S. P. Bush and W. E. Squires.

All the men performing the various duties were well selected, and the records were kept with admirable accuracy, so that the tests furnish really scientific data of great value.

WESTINGHOUSE BRAKE AND TRAIN.

The Westinghouse brake is used on 50 new cars of the Pennsylvania standard, built at Altoona just in time for these tests. The empty weight marked on most of the cars is over 31,000 pounds, but the total weight as found at Burlington was 1,528,850 pounds for the whole train, or a weight of 30,577 pounds per car, a shrinkage of from 500 to 900 pounds per car. The train is fitted with the Janney coupler. The brakes are applied between the wheels, and this is the only company in the test which has the brake-gear hung in this way. The locomotive that handled this train was No. 119, belonging to the C., B. & Q., an ordinary eight-wheel engine, weighing 81,450 pounds, 54,050 being on the drivers.

The train was specially prepared for these tests, and the brake has certain improvements that were first used practically in these tests, but will become a regular part of freight car brakes. To meet the necessity for more rapid action for a very long train than was possible with the old brake, Mr. George Westinghouse lately invented the improvement shown in cuts on next page. Figs. 1, 2, and 3 are sections and plan of the new air brake triple valve. Fig. 2 is a different section of the lower part of Fig. 1. In working the ordinary triple valve of the Westinghouse automatic air brake, air passes in through the train pipe by the openings *a b c*, Fig. 1, into the drain cup *A*, from whence it goes through holes *r*, Fig. 2, into the chamber *B*, pushing up the piston 5 and the slide valve 6, which is attached to the piston. This is the normal position of the apparatus when the train is running. The piston and its slide valve being full up, the brake cylinder is open to the atmosphere by means of the passages and parts *d e f p q*. To apply the brake, air is permitted to escape from the train pipe, which reduces the pressure at *B*, when the higher pressure in the auxiliary reservoir pushes down the piston 5, carrying with it the slide valve 6, thereby putting the auxiliary reservoir, by means of the part *l*, in communication with the brake cylinder. The degree of opening, and hence the quickness of application, is in direct proportion to the reduction of pressure made in the train pipe.

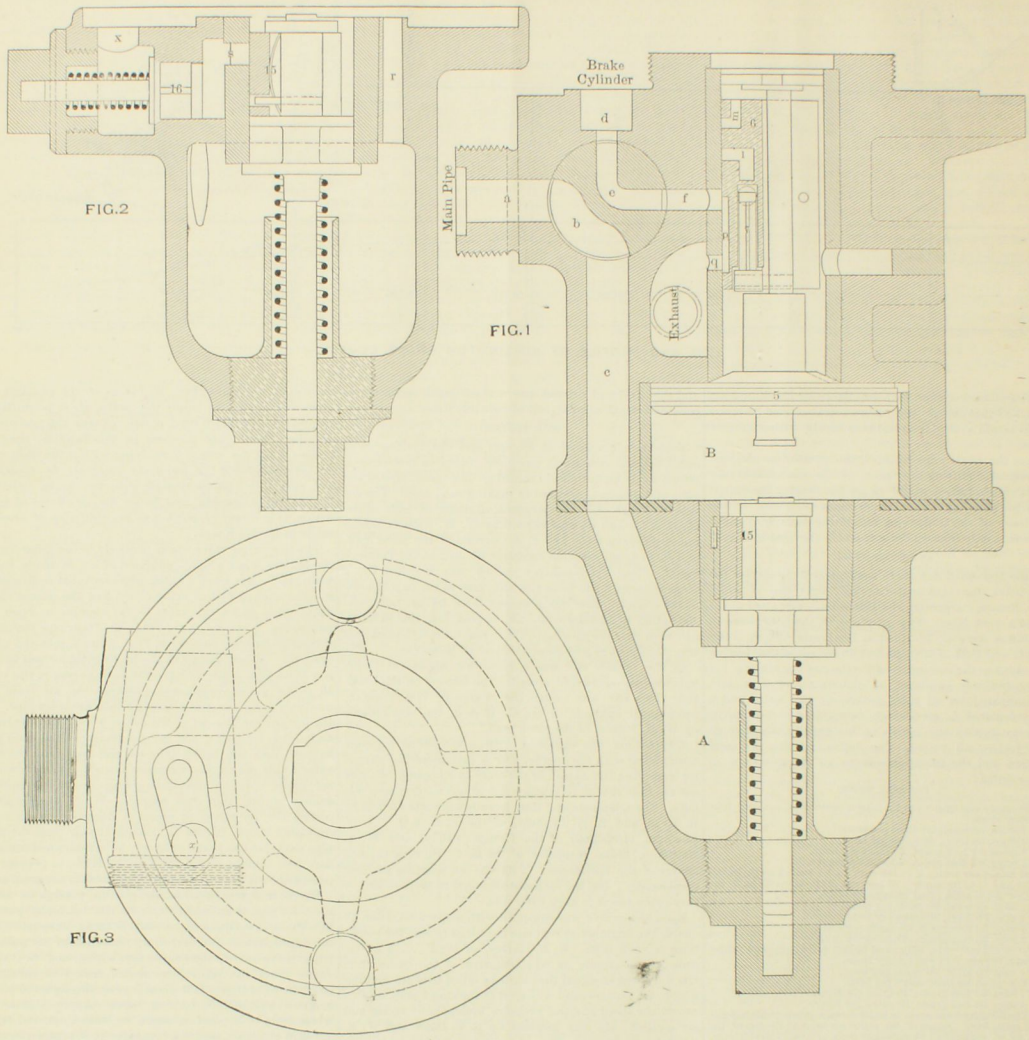
The new triple valve works precisely in the same way as the old one when a light reduction of air is made in the train pipe. But when a quick stop is wanted sufficient air is exhausted at first to make piston 5 of the nearest triple valve push down the valve 15 far enough to open the port *s*, Fig. 2, when the air from the train pipe rushes up through a suitable passage *x*, Figs. 2 and 3, into the brake cylinder. When the air in the brake cylinder and that in the train pipe come to have the same pressure, the valve 16 closes automatically and prevents the air from the auxiliary reservoir from passing into the train pipe. At the instant the descent of the piston 5 moves the valve 15 and opens the port *s*, and permits the air in the train pipe to pass into the brake cylinder, the port *m* on the slide valve 6 puts the auxiliary reservoir in communication with the brake cylinder also, thus giving the brake cylinder a supply of air from two sources. When the engineer makes the reduction of pressure necessary to start the operation which results in letting the air from the train pipe pass into the brake cylinder, he must immediately return the handle of his valve to the latch, to prevent the passage of air from the main reservoir into the train pipe.

By the new arrangement, the greater portion of air in the train pipe is utilized to operate the brake, by passing into the brake cylinders, instead of being exhausted into the atmosphere. The first sharp reduction of air puts the triple valve nearest the engine into action, and the air it draws from the train pipe makes reduction enough to start the next triple, and so on it goes through the whole length of a train of 50 cars or more. Application to the whole train of 50 cars is made by this improved triple valve in about six seconds, compared to seventeen seconds with the old valve, and the company expect to still farther reduce the time.

The train is also equipped with an electric apparatus consisting of a small cell battery, and wire connections for operating escape valves connected with the air pipe at different points on the train. The action is like having an engineer's valve at different parts of the train. Two or three of these valves were used to show how the stops could be made with electricity, but the aim of this company was to make electrical action secondary to the automatic air action of the brake, and to effect stops without electricity that would be perfectly satisfactory under the most trying conditions of train service. The Westinghouse Company was represented by Messrs. T. W. Welsh, W. W. Card, H. H. Westinghouse, Frank Moore and others. Mr. George Westinghouse was present part of the time.

EAMES BRAKE AND TRAIN.

The Eames Vacuum Brake was applied to 50 new cars built by the Wells & French Co. The Boston automatic coupler is used on the cars. The total weight of the empty train was 1,275,000 pounds, or 25,500 per car. The locomotive used for handling the train was No. 286, belonging to the C., B. & Q. The total weight of the engine is 81,550 pounds, 58,750 pounds resting on the drivers. The Eames Automatic Vacuum Brake Company have evidently devoted great attention, care and skill to preparing their brake for the difficult requirements of the tests. A striking feature about the brake equipment is the strength and fine proportions of the mechanism. The vacuum auxiliary reservoirs and brake diaphragms are larger than those used in the July trials, the train pipes are larger, and the connections are much stronger. By means of an admirably worked out system of floating levers, the power is so graduated that increased diaphragm movement gives a corresponding increase of power. Attached to each auto-



THE WESTINGHOUSE NEW TRIPLE VALVE.

matic valve is an auxiliary electrical apparatus, which operates the automatic valve when quick stops are required. The electric current is generated by a small dynamo placed on the running-board of the locomotive and driven by a tiny rotary engine. The brake is of course automatic without the electrical attachments, and the latter were only employed to show how smoothly and suddenly emergency stops could be made. The Eames Company was represented by Messrs. A. P. Massey and F. A. Casey.

THE CARPENTER BRAKE.

The full name of this brake is the Carpenter Automatic Electro-air Brake, and its reputed inventor and owner is Mr. J. F. Carpenter, of Germany, with headquarters at 15 Gold street, New York. So far as an ordinary railroad man can see, the brake is the Westinghouse automatic air brake, with an electrically operated valve in place of the triple valve. The brake is applied to 50 cars built by the Illinois Central Railroad Company, and the cars appeared to be the best built cars on the ground, for they stood the jerking and pounding they received with very few signs of distress, which could not be said of many cars that went through the tests. The total weight of the train was 1,367,500 pounds, an average weight per car of 27,350 pounds. The train was handled by locomotive No. 250, belonging to the Illinois Central Railroad. The engine weighs 84,650 pounds, 54,800 being on the drivers. Electricity is furnished by a Julien storage battery containing six cells, which is carried on the engine. The battery has one ground connection and one connection with the engineer's valve. Wires are carried throughout the train, the connections between the cars being made by metallic contact in the hose couplings. Electrical connection is made between the battery and the train wires by means of the engineer's valve, which operates the electricity and air together. The automatic valve attached to the auxiliary reservoir under each car consists of two distinct valves, one for admitting, the other for releasing the air. These valves are operated by an armature worked by an electro-magnet. The brake is not automatic without electricity, but it may be operated by straight air. The air aump on the engine is laid horizontally above the frame inside the guides on the right hand-side. The motion is that of the Cameron pump.

THE HANSCOM BRAKE.

This brake was applied to 50 cars belonging to the St. Joseph & St. Louis Railroad. Those well acquainted with the development of power brakes could recognize in the Hanscom brake a close relationship to the Steel-McInnes brake, which struggled through a weakly existence for a few years in Britain. The brake has two lines of brake pipe, one connecting with the front and the other with the back end of the brake cylinder. Pressure in one pipe applies the brake, while the other releases. The brake is positive in its action, and has some features very alluring. The most serious weakness of the brake is that it uses a very large volume of air to do its work. The brake was badly constructed, and it failed miserably in its first and only trial, so there is no necessity for further describing its mechanism, as it is never likely to hold an important place in railway machinery.

CARD ELECTRIC BRAKE.

When this brake is closely examined it is found to be an electric brake in the sense that nearly all the other brakes at the trials are electrical. That is, electricity is used to put the brake in action. In reality it is a friction brake operated by a chain belt working on a pulley on one axle of each car. This chain revolves a coned pulley which engages with a friction clutch that carries a small sprocket wheel. To apply the brake, an electro-magnet is used to operate the clutch when the sprocket wheel revolves, and by means of a chain-belt winds up a chain attached to the brake rod. The power is graduated by the pressure which the magnet puts upon the clutch. If a light pressure is applied the clutch slips easily, more pressure increases the friction and proportionally increases the pull on the brake chain.

The electrical part of the brake appears to be worked out very skillfully. An accumulator battery of ten cells is carried on the engine, and another in the caboose, the cells being charged by a dynamo in the shop. They use a closed circuit, but the two batteries are both connected on the same polarity, and no current is going unless when the brake is in operation. When the engineer wants to apply the brake, he cuts off one cell from his battery, which gives him the electromotive force from one cell in the caboose. Increase of braking force is obtained by cutting off more cells.

The train consists of 50 cars belonging to the Cincinnati, Hamilton & Dayton, and engine No. 8 of that road operated the train. The performance of the brake did not promise much more success for electrically operated friction brakes than had been attained by the same type operated by impact.

MAKING THE RUNS.

When a train was ready to make a run, a consolidation engine coupled on to the rear end and pulled it to Middletown, the engine belonging to the train following with the dynamometer car. The train engine coupled on at Middletown, and when all was ready a start was made, the consolidation engine pushing and the train engine pulling.

RECORD OF BRAKE TESTS.

	Speed at stop No. 1.	No. of feet in stop.	Time making stop. Seconds.	Slidometer movement.	Speed at stop No. 2.	No. of feet in stop.	Time making stop. Seconds.	Slidometer movement.	Speed at stop No. 3.	No. of feet in stop.	Time making stop. Seconds.	Slidometer movement.	Speed at stop No. 4.	No. of feet in stop.	Time making stop. Seconds.	Slidometer movement.
WESTINGHOUSE.																
1. General test No. 1, without electricity	19¼	214	11	70⅝	....	....	....	....	....	....	....	....	....	....	....	....
2. " " second run, without electricity	17¾	184	9⅜	103	35½	586	17	70½	....	....	....	....	....	....	....	....
3. " " with electricity	22	181	8	....	36⅝	453	14	....	20	170	8¾	....	40½	614	16	....
4. " " "	20¾	165	7	....	37	475	14½	....	21	163	8¾	....	42	665	16	....
5. Service stop, without electricity	20	524	20½	2	35½	1007	27¾	11⅜	20⅝	488	21	13⅜	39¼	1384	33½	14
6. General test No. 2, with electricity	20¼	202	11¾	....	31	504	19¼	....	21	235	13½	....	32	643	22½	....
7. " " "	20⅝	202	11¾	....	31⅜	501	18	....	21⅜	246	13⅜	....	32⅜	640	21⅜	....
8. General test No. 5, "	20¾	201	11¾	....	30⅜	484	18¾	....	21¼	251	13	....	33	608	22	....
EAMES.																
1. General test No. 1, without electricity	21¾	370	15½	18⅛	38½	896	23	15⅝	20½	386	17⅝	20¼	41	1191	27⅝	16⅝
2. " " second run	21½	363	17¼	20	38¾	872	22⅝	19⅛	21⅛	405	18½	22	42	1162	30⅛	20⅛
3. " " third run	23⅛	403	17	24⅛	40	937	23½	20⅝	20⅛	365	18⅜	25½	40⅜	1008	25	23¾
4. " " with electricity	22	253	10⅜	....	41	616	16½	....	21	251	13	....	41	785	21	....
5. " " "	20⅝	352	16¾	....	....	....	....	....	21	425	19½	12⅜	39¾	640	17⅜	....
6. General test No. 2, "	19	205	12	....	29	462	18	....	20	242	13½	....	30	623	22½	....
7. " " "	15	148	11	....	31	576	21	....	22¾	339	17	....	34	876	27⅜	....
8. " " "	20⅛	314	16	....	33	649	21¾	....	21	332	17	....	31	721	24½	....
9. " " without electricity	20	440	21¾	4¾	30	809	27	5½	20¾	497	22¾	5⅝	31½	1037	32	7¾
CARPENTER.																
1. General test No. 1, with electricity	22½	140	7½	....	32½	300	11	....	23	173	9	....	41¾	565	16	....
2. " " "	23	150	6⅝	....	34	312	12	....	21½	143	7½	....	41	590	17⅜	....
3. " " "	23	133	6	....	36	330	11½	....	22	136	6¾	....	41½	572	16½	....
4. General test No. 2, "	21½	193	11	⅛	34½	572	19⅜	....	21¾	227	13	⅛	36½	871	28¾	⅛
5. " " "	19⅝	132	9¾	⅝	30⅝	396	15½	⅛	22	240	13⅜	⅜	33⅜	717	25¼	1⅜
6. General test No. 5, "	19¾	201	12¾	1¾	29½	510	20	1⅝	21	328	17¾	⅜	33	1241	42¾	2¼

This table gives the record of the principal tests made when our matter had to be ready for the press. An examination of the description of the general tests will show the conditions under which the various runs were made, and will be a guide to making comparisons. Thus, for instance, General test No. 5, a mixed train is run with loose brake-shoes—that is, the shoes hung ½ inch clear of the wheel. In that test the Westinghouse train was stopped in 60.8 feet, on a grade of 53 feet, at a speed of 33 miles an hour. It will be seen that the Carpenter train was stopped, under the same conditions, in 1,214 feet. Other comparisons may be made in a similar way.

When the engineer of the front engine considered that the train was going fast enough for him to maintain the speed required at the stopping post, four rings were given on the telephone, which was the signal for the conductor on the rear car to stop the pusher. Telephone signals were also given of the moment the engine reached the stopping post, and then every wise man on the train clung tenaciously to something that would prevent him from spinning through space, to be brought up harshly by a car end. Very few of the stops tended to pitch the people about on the train, but a few stops in the beginning of the tests, that were all too sudden, taught all concerned to be prepared for the worst.

The record of these tests would not be complete without testimony being given to the persistent manner in which Mr. B. Welch, of the committee, and Mr. L. S. Coffin, railroad commissioner of Iowa, stuck to the rear car, and took all the jolts that were going. Mr. G. W. Rhodes, chairman of the committee, was also there pretty regularly. If these tests settle for railroad companies the kind of brake best adapted for freight car service, a most important share of the success will be due to Mr. Rhodes. His quiet, persistent energy did much to promote action on this question by the Master Car Builders' Association. His rare executive ability, mechanical knowledge, vigor and energy have pushed the tests to a successful issue, all opposition, apathy and difficulties disappearing under his will-power and ability. With a friendly word for every one he has been the idol of all the men attending the tests, and his discrimination and fairness have carried a difficult undertaking along with almost total absence of personal friction.

When a stop was made all the records were taken as promptly as possible. The time, the speed, the distance run and other particulars were noted in the front end; the speed and the brake rod tension were noted in the middle car; the degrees of impact and the time taken to release the brakes were noted in the rear car, and with the least possible delay the signal was given to go ahead, the pusher always being promptly on hand to help in getting up speed for the next stop.

The first three days of the tests were devoted to preliminary runs tending to demonstrate the retarding power of the engine brakes and the resistance of trains. It was only on the fourth day that the experiments began to be interesting to railroad men, and the recent remarkable development of braking power began to be made manifest. The Westinghouse train proceeded to make emergency stops with its 50 cars. The operation was to apply the brakes at their full force without the least preliminary check when the stopping post was reached. This is a stop that in actual service only would be used to avoid a collision or some extremely serious accident. When the brakes for these stops were applied by the engineer's valve alone, the sudden stops made astonished everybody present, but some of them were rather more touched by the violent shocks received in the rear car. A movement of the slidometer weight beyond 12 inches was expected to be dangerous to stock. In one of the stops with this train the weight was moved 103 inches, and nearly all the occupants of the rear car were piled in a promiscuous heap in the front end of the car. It was found, however, that when electricity was used to operate the brakes, stops of the emergency order could be made without any shock. In the first test with their electrical appliances in use the Westinghouse people made a stop on a descending grade of 53 feet to the mile in 665 feet, which up to that time was unparalleled with a train of 50 cars. A variety of tests with the air brake alone demonstrated that the Westinghouse automatic air brake for freight cars can make stops without any electrical apparatus as suddenly as most railroad men want to have their trains handled.

The Eames brake also worked very satisfactorily, indeed, with and without electricity.

The Carpenter brake made some of the best stops recorded, but all its work was done by electricity, and every valve being operated in this way made the brake exceedingly quick in application and release.

When the five smooth stops with electricity were first made, a few of railroad men present began to predict that electricity was the coming mode of operating brakes, but some incidents observed before the trials ended convinced a good many that the day of triumph for electricity was not so near at hand as they thought it was. Although the men in charge of the brake trains having electrical apparatus were evidently better acquainted with the manipulation of electricity than trainmen might be expected to be for half a century to come, there was considerable trouble with the electricity. The Eames brake had the electrical connections burned out and otherwise out of order several times. Several cars had to be cut out of the Carpenter train because something was wrong so that the valves could not be operated, and the Card brake came to grief on its first run through the electric current starting away out of time and applying the brake, with the result that an armful of friction pulley chains were broken off. Mature reflection was not calculated to increase the number of fast friends of electrically-operated brakes.

After the accident to the Card brake referred to it was taken off the course to repair damages. It came up smiling another morning, but a moderate application of the brake broke so much of the apparatus that the train was taken home.

The Hanscom brake train made one run over the course and made three stops that would have been a fair performance for three brakemen. In the No. 4 stop the train had to be stopped by brakemen, and the contest was abandoned.

The American Brake Company's brake had not arrived at Burlington when our notes had to be closed.

Use of Steel in Russia.

The Russian Ministry of Railways has published a series of provisional regulations concerning the use of steel, of which the following is a summary:

1. Steel, whether Bessemer or Siemens-Martin, may be used in all structures.

2. In view of the great sensitiveness of steel to mechanical working, it is to be noted that:

(*a.*) Plates and other sections must be tempered, after rolling, by means of the sand-bath. Care must be taken that on leaving the rolls the metal is not below a cherry red heat.

(*b.*) Holes must not be punched, but drilled.

(*c.*) When worked cold, the material must not be sheared, but cut with a chisel. The edges must be planed. All boring must be done hot, and provision be made for subsequent slow cooling.

3. The material must possess the following properties:

(*a.*) It must contain from 0.05 to 0.20 per cent. of carbon.

(*b.*) Except for rivets, the tensile strength of all kinds of steel must be from 25.4 to 29.8 tons per square inch, extension at least 18 per cent., and the contraction of area at least 36 per cent.

For rivets, the tensile strength must be from 22.2 to 25.4 tons per square inch, extension at least 20 per cent., and contraction of area at least 50 per cent. The percentage of carbon for rivets must approach the lower limit (see *a*). Extension and contraction of area are to be measured on test pieces of 10 inches in length. The test pieces must be worked cold.

4. A strip of metal 10 or twelve inches in length, heated to cherry red, and then plunged into water at 85½ degrees Fahr., must not show any cracks when so bent that the inner faces of the bent piece, at a distance from the angle of one-and-a-half times the thickness of the plate, are three times the thickness of the plate apart.

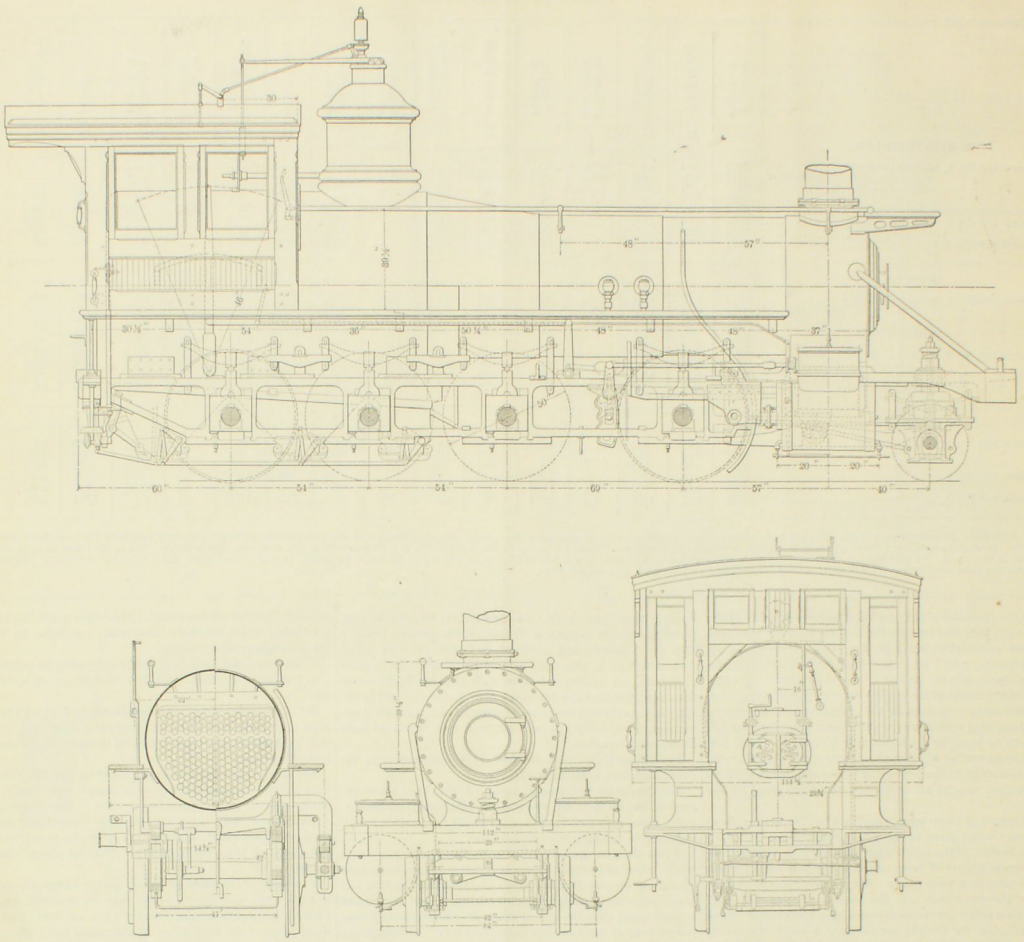
5. The permissible strain upon the material is as follows:

(*a.*) For bridges of less than 49 feet span, and also for roadway bearers (longitudinal and cross):

	Tons per sq. in. Steel.	Iron.
For tension and compression	4.4	3.8
Shearing of rivets, fastening the longitudinal to the cross-bars, and these to the main girders	3.8	3.2
Shearing of rivets in the rest of the structure	4.4	3.8
Shearing of the web of a plate girder	2.9	2.2
(*b.*) For main girders of bridges of from 49 to 95 ft. span:		
Compression (after deducting half area of rivet holes)	4.8	4.4
For tensions (net cross-section, after deducting rivet holes)	4.8	4.4
Shearing of rivets	4.4	3.8
(*c.*) For main girders of bridges of more than 95 ft. span:		
Tension (net cross-section, after deducting rivet holes)	5.1	4.6
Compression (after deducting half area of rivet holes)	5.1	4.6
Shearing of rivets	4.4	3.8
(*d.*) For wind-bracing of bridges of more than 95 ft. span:		
Tension (net cross-section)	6.3	5.7
Compression (after deducting half area of rivet holes)	5.7	5.7
Shearing of rivets	5.1	4.8

Iron and steel may be used in the same structure, but with the limitation that in each member of a group of similar parts the same material is to be used. For instance, the top and bottom booms of a girder form such a group; the diagonals and verticals of a girder, the cross and longitudinal roadway bearers, are other such groups. The use of steel rivets is not compulsory with steel plates. —*Railway Engineer* (*London*).

A CONDUCTOR on the Burlington road was asked by a Cedar Rapids (Ia.) *Gazette* man how trade was. The conductor replied: "This Inter-state law is extracting the tar right out of the Pullman company. You wonder why? Well, when people ride on passes they generally take a berth on the sleeper, because they felt that was equivalent to paying fare. Now that they have to pay fare they cannot afford to pay for sleepers. The same people, if they are compelled to take a trip, suddenly discover that the sleepers are poorly ventilated and conducive to bad health."



CONSOLIDATION LOCOMOTIVE (CLASS I) NEW YORK, LAKE ERIE & WESTERN RAILROAD.

The engravings illustrate Class I. modified consolidation locomotive belonging to the New York, Pennsylvania & Ohio Railroad, operated by the New York, Lake Erie & Western. The engine is designed for burning bituminous coal, and the proportions represent the ideas entertained by Mr. R. H. Soule as the best for an engine of this type. The engines are reported to give great satisfaction in service.

The following are a few of the principal dimensions:

Total weight in working order	108,000
Weight on drivers	95,500
Weight on truck	12,500
Distance between centers of front and rear driving wheels	14 ft. 9 in.
Total wheel base	22 " 10 "
Diameter of driving axle journals	7 "
Length " " " "	8 "
Diameter of main crank pin bearing	5 "
Length " " " "	6 "
Diameter of cylinder and stroke of pistons	20 in. × 24 "
Length of steam ports	16 "
Width " " "	1¾ "
Width of exhaust ports	2½ "
Outside lap of valve	⅞ "
Inside " "	0 "
Exhaust nozzles	Double.
Diameter of boiler	Smallest ring, 53¾ in.
Material of boiler	Steel.
Thickness of shell	⅞ in. and ¾ in.
Number of tubes	290
Length " "	Between tube plates, 13ft. ½ in.
Outside diameter of tubes	2 "
Length of fire-box inside	10 ft. 2⅛ "
Width " " "	At grate, 2 ft. 9 "
Depth " " "	Back, 44 in.; front, 56½ "
Height of crown sheet above grates	" 38 " " 56½ "
Thickness of flue sheet	½ "
Sides and back	⅜ "
Crown	⅜ "
Grate area	27.97 sq. ft.
Heating surface of fire-box	141.65 " "
" " tubes, external	1,181.80 " "
Flue area through tubes	3.378 " "
Capacity of tank	3,200 gals.

THE NATIONAL PAINT WORKS, of Williamsport, Pa., have lately received several large orders for their "Asphaltum Paints" to go to railroad companies in South America.

Steam and Motive Power.

BY ANGUS SINCLAIR.

(*Continued from page 58.*)

MEASURING THE STEAM THAT PASSES THROUGH THE EXHAUST.

Reckoning the quantity of steam that should be used in a cylinder by calculating its cubic content, the point of cut-off, and the pressure of steam does fairly well as a means of finding out the amount of power likely to be developed with a certain cylinder capacity; but when the question arises of how much steam a cylinder is actually using to do the work required of the engine, a more accurate method must be adopted. No engine takes steam into the cylinder at boiler pressure, very few cylinders hold the steam to an even pressure up to the point of cut-off, and no engine is worked without more or less back pressure. The amount of these disturbing elements can not be estimated near enough for practical purposes, and the indicator diagram is universally used as a medium of calculation by those who wish to find out with any degree of accuracy how much steam an engine is using.

The indicator diagram does not account for all the steam that passes into a cylinder, but its record is the best that science and mechanical ingenuity have yet produced. When steam flows from a boiler into a cylinder it goes into a comparatively cold vessel, with the result that part of the heat contained in the steam is used to raise the temperature of the metal of the cylinder. As saturated steam is always at the dew point, or ready to fall back into water on the abstraction of any heat, the steam which gives up its heat to the cylinder becomes water, or, in other words, is condensed. The steam condensed in this way loses its work-performing energy, it applies no propelling force to the engine piston, and therefore does not act upon the piston of an indicator, so it exerts no direct influence on the diagram.

Engineers have found that the most accurate way of estimating the steam accounted for by the indicator diagram, is to calculate the volume or steam that passes out through the exhaust. This is done in several ways. A common way is the selecting of a point on the diagram just previous to the opening of the exhaust, and there measuring the pressure of steam above vacuum. The displacement of the piston in cubic feet up to that point, plus the clearance space multiplied by the weight of a cubic foot of steam of the pressure selected, will give the weight of steam present.

THOMPSON'S METHOD OF FINDING THE QUANTITY OF STEAM USED.

A method of estimating the steam indicated by the diagram, which is very convenient and easy of application to locomotive work, is that prepared by Mr. E. W. Thompson for use of the Buckeye Engine Company. To apply the plan a knowledge of the mean effective steam pressure of the diagram is alone essential. Let us calculate the steam consumption represented by the diagram, shown in Fig. 2, by Mr. Thompson's method. The diagram was taken from engine No. 50, belonging to the Chicago & Northwestern Railway. The cylinders are 16 × 24 inches, drivers 5 feet 3 inches diameter, boiler pressure was 135 pounds by gauge, and the engine was making 228 revolutions per minute when the card was taken. The indicator spring was 80 lbs. to the inch. All these particulars are not necessary for calculating by the Thompson process the steam used, but they may be interesting for other purposes.

We draw a vertical line at each end of the diagram defining its exact length. The expansion line is continued by a dotted line from the point of release x to the end of the diagram t, making the expansion curve what it would have been had the valve not opened till the end of the stroke. From the point t, or height of unreleased terminal pressure, we draw the line $t\ c\ i$ parallel with the atmospheric line. At t the terminal pressure above the vacuum line is measured, and found to be 34

pounds. In the annexed table, which is condensed from one used in Hemenway's Indicator Practice, we look for the number opposite T P 34, and find it to be 1,152.26. The columns in the table give the steam represented by pounds and half pounds, that being as near as can be measured correctly with the strong springs used for locomotive indicator work.

The number found has to be divided by the mean effective steam pressure of the diagram, and the quotient will be the amount of steam used per horse-power per hour, without taking into account the discrepencies due to clearance and compression. Allowance is made for these by multiplying the amount of steam by 2.5, the length in inches of the line $t\,c$, and dividing the product by 3.219, the length in inches of the line $t\,i$ or total length of the diagram. The complete problem is $1{,}152.26 \div 43 = 26.8 \times 2.5 = 67 \div 3.219 = 20.8$ pounds of steam exhausted per horse-power per hour, as shown by the indicator. This does not give any account of the loss of steam due to cylinder condensation.

THOMPSON'S COMPUTATION TABLE

T P		T P		T P		T P		T P	
	11.0	398,640	21.0	732,690	31.0	1,056,480	41.0	1,374,32[illegible]	51.0	1,088,106
	11.5	415,725	21.5	749,060	31.5	1,072,418	41.5	1,390,043	51.5	1,703,930
	12.0	432,720	22.0	765,380	32.0	1,088,340	42.0	1,405,740	52.0	1,719,120
	12.5	449,688	22.5	781,763	32.5	1,104,350	42.5	1,421,413	52.5	1,734,600
3.0	117,300	13.0	466,570	23.0	798,100	33.0	1,120,350	43.0	1,437,060	53.0	1,750,060
3.5	135,748	13.5	483,435	23.5	814,393	33.5	1,136,420	43.5	1,452,900	53.5	1,765,500
4.0	153,880	14.0	500,220	24.0	830,640	34.0	1,152,260	44.0	1,468,720	54.0	1,780,920
4.5	171,945	14.5	517,070	24.5	846,965	34.5	1,168,170	44.5	1,484,520	54.5	1,796,320
5.0	189,750	15.0	533,850	25.0	863,250	35.0	1,184,050	45.0	1,500,300	55.0	1,811,700
5.5	207,598	15.5	550,638	25.5	879,495	35.5	1,199,900	45.5	1,516,060	55.5	1,827,358
6.0	225,240	16.0	567,360	26.0	895,700	36.0	1,215,720	46.0	1,531,800	56.0	1,842,960
6.5	242,970	16.5	584,100	26.5	911,865	36.5	1,231,603	46.5	1,547,520	56.5	1,858,568
7.0	260,540	17.0	600,780	27.0	927,990	37.0	1,247,640	47.0	1,563,220	57.0	1,874,160
7.5	278,063	17.5	617,400	27.5	944,075	37.5	1,263,563	47.5	1,578,900	57.5	1,889,738
8.0	295,440	18.0	633,960	28.0	960,120	38.0	1,279,460	48.0	1,594,560	58.0	1,905,300
8.5	312,800	18.5	650,460	28.5	976,268	38.5	1,295,333	48.5	1,610,200	58.5	1,920,848
9.0	330,030	19.0	666,900	29.0	992,380	39.0	1,311,180	49.0	1,625,820	59.0	1,936,380
9.5	347,273	19.5	683,378	29.5	1,008,458	39.5	1,327,003	49.5	1,641,420	59.5	1,951,898
10.0	364,400	20.0	699,800	30.0	1,024,500	40.0	1,342,800	50.0	1,657,000	60.0	1,967,400
10.5	381,570	20.5	716,270	30.5	1,040,508	40.5	1,358,573	50.5	1,672,560	60.5	1,982,888

WORK OF A COMMON LINK MOTION LOCOMOTIVE.

That steam distribution shows the work done by a common link motion engine cutting off at about 7¼ inches and running at a fairly high speed, the piston speed having been 912 feet per minute. With a moderate quality of coal the engine would appear to do the work with little more than three pounds of coal per horse-power per hour. The diagram looks inferior compared to those ordinarily taken from automatic engines, and it is small compared to the theoretical diagram, but the absence of a horizontal steam line, or the want of distinctly defined points of cut-off, release and the beginning of compression do not always render it certain that the engine is making inferior use of the steam passed through the cylinders.

This is a fairly representative diagram for an American locomotive working with the throttle full open, the reverse lever well hooked up; and something exceedingly close to its outlines would be got from the majority of our passenger engines that can do their work in the first notch ahead of the center. This engine has a high exhaust pipe of ample proportions, and a single nozzle which gave free afflux of steam and kept the counter pressure very low.

Through the action of somewhat high compression, the steam inside the cylinder is almost equal to boiler pressure when the piston begins its stroke, but as the piston moves away from the cylinder head, the flow of steam is not sufficient to keep the increasing volume of cylinder full, and what Hemenway calls initial expansion is present from the beginning of the stroke. That is, the passages and valve opening not being large enough to admit sufficient steam to maintain the initial pressure, the steam expands and the pressure falls before cut-off takes place. This reduces the power of an engine, but it is doubtful if it detracts much from the economical use of steam. The link motion closely hooked up, leaves such a limited valve travel that the events of the stroke are not sharply defined on the lines of the diagram, the exact points of cut-off, release and beginning of compression being hard to identify. A fault that many engineers would find in the diagram, is the great amount of compression, but those who have investigated the subject of cylinder condensation most thoroughly are disposed to hold that compression, while kept within fair limits, is no source of heat waste. While compression is merely sufficient to raise the steam in the cylinder at the beginning of the stroke to steam chest pressure it cannot be called excessive.

EVIL EFFECT OF THROTTLING.

The diagram shown in Fig. 3 was taken from the same locomotive under what would be regarded among railroad men as merely slightly different conditions from the other one, yet the slight change in conditions materially affects the economical operation of the engine. The boiler pressure was 135 pounds, the speed was 132 revolutions per minute, or 528 feet per minute of piston speed, and the reverse lever was in the 9-inch notch, which in reality permitted the steam to follow the piston 10¼ inches of the stroke. The boiler pressure was the same as when diagram No. 2 was taken, but the initial cylinder pressure in this instance was only 100 pounds, as compared with 135 in the other case. There was less compression in the diagram No. 3, but the principal cause of the reduced cylinder pressure was that the engine was worked with the throttle partly closed. At the comparatively slow speed of the piston there was no reason why the cylinder pressure during admission should not be within eight per cent. of boiler pressure, but in reality it is twenty-six per cent. below boiler pressure. The man who handles the throttle is alone to blame for this. It results from engineers not being properly impressed with the importance of working their engine so that the full ratio of expansion shall be obtained. The engine is allowed to drag along with a light throttle and the lever in the 9-inch notch, when it ought to be hooked up to 6 inches and the throttle opened wide. With a full throttle, in the 6-inch notch, at the speed reported, this engine would have developed as much power as she did in the 9-inch notch with the throttle partly closed, and the steam would have been used to greater advantage. The practice of marking the quadrants different from what the real points of cut-off are is responsible for much waste of steam, and was so in this instance. The first two notches were marked 6 and 9 respectively, and the real points of valve closure were 7½ and 10½. An engineer gets to think he is working his engine to good advantage at 6 inches, and 9 inches does not appear to be letting the steam follow too far. If the man at the throttle understood that, instead of being cut-off at 9 inches, the steam was following the piston nearly half stroke when the lever was in the second notch, he would, in nearly every instance, link up more promptly.

It has always been admitted by those best able to judge, that the safe and economical operation of American railroads has depended greatly upon the intelligence and care of trainmen. The engineer is one of the most important factors in this element, and it is right that his natural care and intelligence should be developed. This can not be done by ignoring his needs. The road that permits the locomotives to run with the quadrant notches wrongly marked is deceiving the engineer, and the mechanical management is to blame for waste of coal that results.

Let us examine the testimony of diagram No. 3 and compare its record with the previous example. The mean effective pressure is 52.6 pounds. The terminal steam pressure is 45 pounds above the vacuum line. In the Thompson table, 45 gives 1500.3. The total length of the diagram is 3.2[illegible] inches; the distance from t to c is 2.9375. The computation of the steam used is then $1500.3 \div 52.6 = 28.52 \times 2.9375 = 83.777 \div 3.25 = 25.8$ pounds of steam exhausted per horse-power per hour. That is using close to one-fifth more steam to do the work, which could be saved by merely pulling up the reverse lever one notch. A locomotive doing the kind of work this one was employed upon uses about 50 pounds of coal per train mile. A change which is calculated to reduce this coal consumption to 40 pounds per mile would effect material reduction in the operating expenses and is worth looking into.

Boiler Pressure

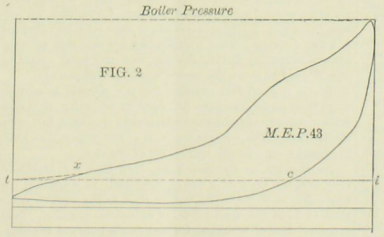


FIG. 2

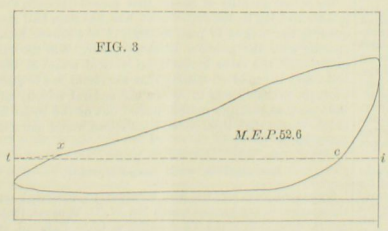


FIG. 3

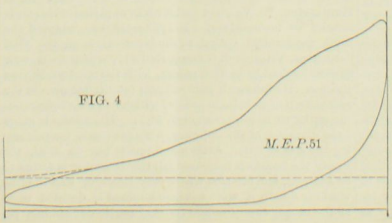


FIG. 4

EFFECT OF KEEPING THE THROTTLE WIDE OPEN.

That a fairly high mean effective pressure can be maintained in the cylinders of a good link motion cutting off short, is proven by Fig. 4, which was taken from engine No. 50, belonging to the Chicago, Alton & St. Louis Railroad while running at 192 revolutions per minute, a piston speed of 768 feet. The boiler pressure was 140 pounds, and the initial cylinder pressure is 135 pounds. Working with an average cylinder pressure almost as high as that maintained by the illustration given in Fig. 3, this engine had a terminal pressure of 39 pounds, yet the work was done with an expenditure of 21.3 pounds of steam per horse-power per hour. The axiom of steam engineering, "get the steam into the cylinder at high pressure and exhaust it at low pressure," was followed as closely as possible with the Chicago, Alton & St. Louis engine, and the work was done at small expense.

VELOCITY OF STEAM.

The utility of high-pressure steam as a means of transforming heat into mechanical work results in a great measure from its expansive force, and the velocity and freedom with which steam passes from one vessel to another or out into the atmosphere. The velocity of the flow of steam depends directly upon its pressure, and is as the velocity of a body falling freely by gravity from a height equal to the column of steam represented by the steam pressure, or to the difference of level between the height of the column of steam and the height represented by the pressure of air or other vapor into which the steam is passing. One exception to this is that the velocity of steam flowing into a vacuum is constant at all pressures.

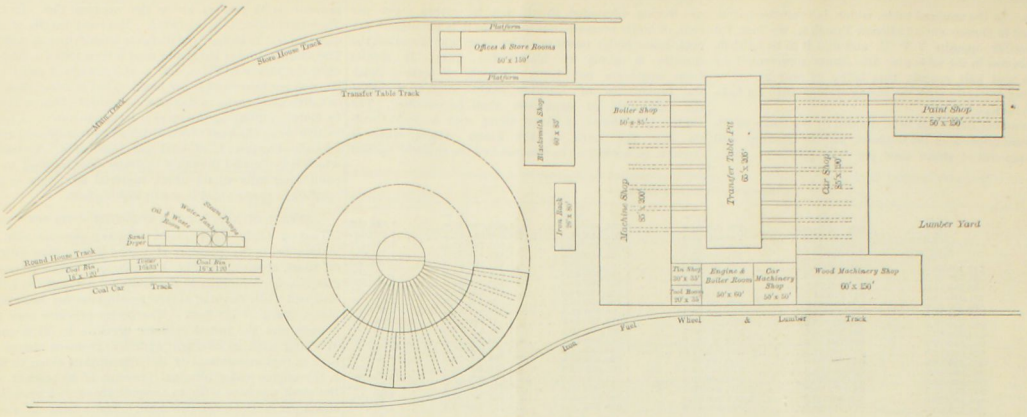
To calculate the velocity with which steam of any given pressure passes into a medium having a pressure equal to the atmosphere, the following process may be followed: The required height of the column of steam is estimated by its proportion to a column of water due to a certain pressure. The square root of the height multiplied by 8, that well-known rule regarding falling bodies, gives the velocity of steam due to the pressure. Suppose we wish to find out the velocity of steam of 10 pounds pressure above the atmosphere. It is well known that one pound of pressure represents a column of water 2.3 feet high, and 10 pounds pressure will represent a column of water 23 feet high. At that pressure above the atmosphere, one pound of steam occupies 1,008 times the volume of a pound of water. So $23 \times 1{,}008 = 23{,}184$, the height of the column of steam. Then $\sqrt{23{,}184} \times 8 = 1{,}218$, the velocity in feet per second of steam of the pressure given. A small fraction is omitted, but the result is nearly enough correct for practical purposes.

The quantity of steam of any pressure that will pass out of a safety valve, a whistle slot or other opening can be calculated by this rule; but it is found that when the opening is made in a thin slot the escaping jet of steam suffers a contraction, so that its area is reduced from 30 to 50 per cent.

To calculate the velocity with which steam will pass into a cylinder or other vessel that is already filled with vapor above atmospheric pressure, the difference between the two pressures has to be taken. Suppose we have a steam chest pressure of 100 pounds above the atmosphere, and at the beginning of the stroke the cylinder has a pressure of 35 pounds due to back pressure and compression. The question is, at what velocity will the steam begin to pass from the steam chest into the cylinder? Deducting the lower pressure from the higher one will give the basis for a column to generate the velocity. The velocity of steam passing from any higher to a lower level may be found at any point by this process.

(To be Continued.)

THE C. B. & Q. Railroad Company are making an arrangement for the running of their freight train crews that is new to Western roads. A whole set of hands, conductor, engineer, fireman and brakemen, will be assigned to one engine, and they will always go together. There are several advantages to the plan, and there is no real obstacle to its working smoothly. The ordinary way is for an engineer and fireman to keep together generally with one engine, and for a conductor and two brakemen to go together in connection with a certain way car.



NEW SHOPS OF ST. PAUL & DULUTH RAILROAD, AT CLAYMONT, MINN.

The engraving shows the plan of shops to be erected this summer at Claymont, near St. Paul, by the St. Paul & Duluth Railroad Company. The shops have been designed by Mr. Charles F. Ward, master mechanic, and special attention has been devoted to arranging the buildings in the most convenient way possible for the present handling of work and for the future extension of the establishment. Any company contemplating the erection of small shops that are likely to need enlargement within a few years, would do well to study the plan of the St. Paul & Duluth shops.

The Waste of Whistling.

The nuisance of the steam whistle in populated neighborhoods has been frequently mentioned, and in some localities municipal ordinances and railroad managements have restricted its use. But it is seldom that the cost, expense and waste of the steam whistle is mentioned. And yet the blowing off of steam through locomotive whistles alone must entail an enormous waste of fuel. From recent reports it is seen that there are 1,940 grade crossings in the two States of New Hampshire and Connecticut. Probably not less than an average of twelve trains cross these roads daily; at each a locomotive whistles under a pressure of about 110 to 120 pounds the square inch. The aggregate amount of steam thus blown off into noise is very great.

The steam from a whistle escapes in an annular space around the bowl; and if the whistle is six inches diameter and the annular space is only one-thirty-second of an inch wide, the total escaping space will be more than one-half square inch. That much steam is required to supply a steam whistle is evident from the fact that all steam whistles have for their connecting stems very generous steam pipes; and also from the fact, patent to every observer, that as dense a cloud of vapor is formed from the steam of the whistle as that escaping from the safety valve in the same time.

The superintendent of one of the most important railroads in the country, himself a practical engine driver, says that when he was a locomotive engineer he was requested by a committee of local political demonstration to persistently toot his whistle as he approached the depôt from a point nearly a mile from the station. He did so, and ran his steam down so that his passengers had either to walk from the stationery train or wait until steam could be gotten up. The writer once, in whistling two refractory oxen off his road, ran his steam down from 110 to 80 within less than two minutes, and the fireman piling in the wood all the time. The superintendent to whom reference has been made believes that for the time the ordinary steam whistle is used, more steam is required than is used for driving the locomotive, with its double cylinders and pulling a train of cars. The whistle demand of steam is a constant one during its use—not intermittent like the admission of steam to an engine cylinder, and the size of the pipe—not less than one and a half inches—permits a very large amount of steam to escape under a pressure of 120 pounds to the square inch. This authority, with others of practical knowledge, says that thirty-five cents per day for the tooting of steam whistles on running trains is a very low estimate of the cost. This does not include depot yard work.

A still more exact statement is that of a well informed railroad man, who says that the expenditure of fuel for each locomotive on the New York, New Haven & Hartford road each day is about one-eighth of a ton; this only for the legally required soundings at grade crossings. This would make, for this one road, the cost of fuel, for grade crossing steam whistling alone, not less than $15,000 per year.

When we read the above article in the *Scientific American* several months ago, we received the impression that the objections raised against whistling on account of the waste of steam rested on no better basis than ordinary guessing. We cut out the article intending to find out by some reliable tests how much steam passed out through an average whistle in a given time. We consider the incessant whistling indulged in by some locomotive engineers an aggravating nuisance, notwithstanding the fact that we have taken part in raising a considerable share of that kind of noise in days gone by; but we scarcely believed that the whistle was such a wasteful appliance as our contemporary made it out to be. Through the kindness of Mr. Henry Schlacks, superintendent of motive power of the Illinois Central, we were recently permitted to make tests with a standard mogul locomotive belonging to the road, to see how fast steam passed out through the whistle. The annular opening of the whistle was $\frac{3}{64}$ wide, and the circle was 5¼ inches diameter, giving a total opening of $\frac{1}{10}$ of a square inch. The valve opening and size of pipe connection with the dome were amply sufficient to supply steam to fill this opening.

We commenced by blowing off the steam through the whistle from 130 pounds to 50 pounds gauge pressure, and noting the time consumed and fall of water in the glass for every five pounds of steam reduced on the gauge. It took six minutes and fifty seconds to reduce the steam from 130 to 100 pounds, and the water in the glass fell $1\frac{3}{16}$ inches. When the blowing off was finished, we filled up the boiler to its original water level, and measured off sufficient to let the water fall again to the point where the steam was reduced to 100 pounds. This $1\frac{3}{16}$ reduction of water in the glass represented 60 gallons of water, or 500 pounds. As the average evaporation of water in locomotive boilers does not exceed 5 to 1 of fuel, there would be about 100 pounds of fuel used up by six minutes and fifty seconds of whistling. Two hundred miles is a long average day's run for a locomotive. Suppose the engine whistles for three seconds in every mile. In approaching stations a longer scream would be indulged in, but there are often several miles passed without furnishing an excuse for a toot, so three seconds per mile may be accepted as a fair average. That would make ten minutes of continuous whistling during the day, and the total quantity of coal used to make the steam would be 146 pounds.

This is a good full average, for the whistle is seldom more than an instant kept full open in whistling, and that with which the experiments were made was kept full open all the time. The whistle was also of the largest size, both in regard to the length and width of the slot.

The engines on the New York, New Haven & Hartford road that use up ¼ of a ton of coal daily in whistling for crossings, must make the welkin ring, as the whistle valve must be kept full open a total of seventeen minutes. That is a good deal of whistling for five or six hours of running.

The actual quantity of steam that passed through the whistle opening in the experiment was less than half the quantity that ought to pass through .8 of a square inch opening with the pressure of steam used. But the obstruction of the valve between the body of steam in the boiler and the kind of opening that the steam has to pass through, probably acts to reduce the natural velocity of the steam, so that the volume passed out of the boiler is much smaller than theoretical calculations would make it out to be.

Locomotives with Large Nozzles.

Some two years ago we had occasion to comment on the extraordinary success which Mr. W. H. Thomas, then master mechanic of the Chesapeake & Ohio Railroad, at Huntington, W. Va., had met with in applying wide single nozzles to locomotives. Mr. Thomas has adapted the same mechanical policy to the locomotives on the East Tennessee, Virginia & Georgia Railway, where he is now superintendent of motive power, with the most gratifying success. He follows a uniform and intelligible plan in the application of the single nozzle, which in every instance is the outlet to a high exhaust pipe. The nozzle is made ⅓ the diameter of the cylinder, with provision for increasing the size at will. After an engine is put on trial, the size of the nozzle is increased till the steaming is found to be affected, and the size where easy steaming and the free working due to a wide nozzle combined is decided upon as the proper size of nozzle for that particular engine. He has some passenger engines 17 × 24 inches, running with nozzles 4¼ inches diameter, each of them having started out with the nozzle 4¼ inches diameter. These engines run 240 miles, doing hard work, without having the sparks cleaned from the extension front. Every slight increase of nozzle diameter is found materially to increase the distance an engine can run before the smoke-box must be cleaned of sparks.

Some consolidation locomotives belonging to the road, with cylinders 20 × 24 inches, are running with nozzles 5 inches diameter. The company have ordered 14 new consolidation engines from the Baldwin Works, and they will have nozzles 5½ inches diameter, and the officers have no fear but they will steam satisfactorily. There is no doubt that the East Tennessee, Virginia & Georgia people are working in the right direction to obtain more work than is usually taken from the heat represented by the fuel used. There is no use of talking about resorting to the compounding of locomotives as a means of heat saving, while so much of the fuel energy is thrown away by inordinately contracted nozzles that keep the smoke-box temperature one-third as high as the temperature of the fire-box.

Car Lighting by the Julien Electric System.

The trial of this system on the Boston & Albany road has proved so successful that General Manager Barnes has ordered 4 tons of 30-cell storage batteries for the equipment of 4 additional cars. A battery of this weight, say 1,000 pounds for each car, will supply 22 incandescent lamps of 16 candle-power for 7½ hours, or 15 lamps for 10 hours. In regard to the cost of the system a writer in the *Electrical World* says:

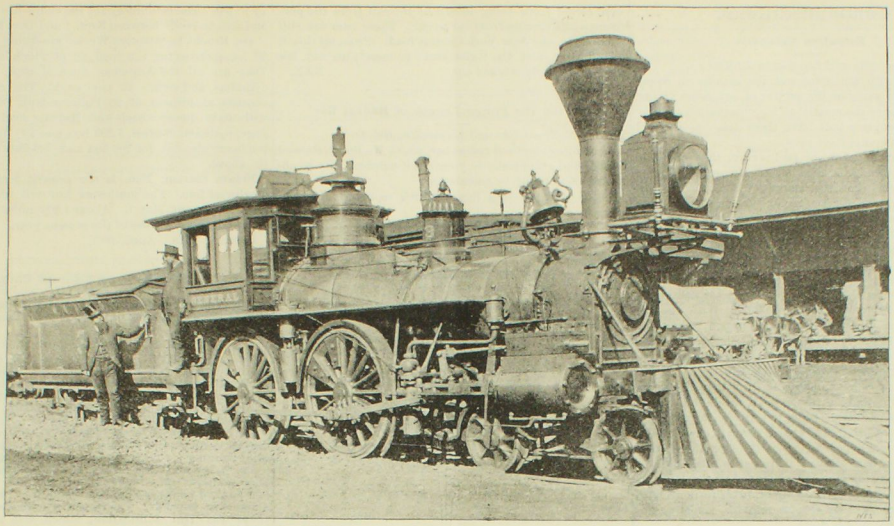
"It is assumed that the depreciation is 50 per cent. per year, and at the end of two years the batteries require renewal; the negative plates will be in as good condition as when first used, and the only cost for renewal would be the cost of positive plates and the cost of fabrication. This latter amount would be offset by the price of the metal in the positive plate, so that the apparent depreciation of 50 per cent. would be reduced to 25 per cent. per year. Assuming that it is 30 per cent., it can then be estimated within a fraction of a cent the cost of operating 1-16 c. p. lamp per day. Using the figures obtained from the Boston & Albany road, we have:

60 cells, at $13, costing $780, depreciation at 30 per cent. =	$234.00
24 lamps, at 85 cents, cost $20.40, if each lamp lasts 2 months, 6 renewals per year would be required at $20.40 =	122.40
Charging battery, 365 days, at 75 cents =	273.75
Interest on $930, cost of installation at 4 per cent. =	37.20
Total cost of 24 lamps per year =	$667.35
Cost of 24 lamps one day =	1.83
Cost of one lamp per day =	7.63 cents

"In this estimate the outside figures have been taken, as, for instance, with the lamps, whose life was exhausted at 600 hours. The average life is far above this. Again, 75 cents for charging is at least 50 per cent. higher than would be the actual cost were the companies to charge their own batteries.

"The Julien Electric Co. guarantee their battery for two years. The actual life of the battery is probably much longer, as upon examination of the plates two years after use they have shown no apparent depreciation.

"The officials on the different railroads estimate that the cost of an oil lamp, including depreciation, breakage, oil and attendance, is about 15 cents per lamp per day. At this rate, the companies could afford to replace each oil lamp with two electric lamps, without any increase in the cost of lighting the car, and add materially to the comfort and safety of their patrons."



THE WAR ENGINE "GENERAL." *(Owned by the Western & Atlantic Railroad.)*

The engraving, which is a reproduction from a photograph, represents this engine as it now appears. It is owned by the Western & Atlantic Railroad, and has become historical from the part it was made to play in the late civil war. On the 12th of April, 1862, while running on this road with a train filled with confederate soldiers, it was detached from the train by a party of union raiders, who started with it for Chattanooga, intending to burn the bridges behind them and prevent reinforcements from reaching that city. The fuel, however, gave out, and the capturers were compelled to flee to the woods, where seven of them were caught and afterwards hung. Of those who escaped, ten are still living, six of whom belonged to the 21st and three to the 33d Ohio regiments, and one was from Iowa.

Central Pacific Notes.

Mr. A. J. Stevens, general master mechanic of the Central Pacific Railroad, is building 37 new locomotives at the company's shops at Sacramento. Several of them are heavy engines of the El Gobernador type, with Stevens valve motion, which is reported to be giving entire satisfaction mechanically, and as a means of saving steam.

Mr. B. Welch, general master car-builder of the road, is building 400 new freight cars. All the cars Mr. Welch is in charge of, both passenger and freight, except 17, are equipped with the air brake. On the many mountain grades operated by the road, the air brake has been found thoroughly efficient for holding trains, but the mechanical department are now putting the water brake upon most of the locomotives as an auxiliary.

An engineer named Sweeney, running on the Southern Pacific, has invented and patented a method of pumping air into the train pipes by reversing the locomotive. The intention is to use that as an emergency resort in case of the air pump failing to work.

Before air brakes came into use, Mr. Welch devoted great attention to making his hand brakes on freight cars as effective as possible, the heavy grades common to the road demanding particular efficiency in freight car brakes. One improvement that Mr. Welch effected in this department some fifteen years ago, was an arrangement that applied from one staff the brakes to all wheels on the car. Three years ago some parties in Colorado patented the method used by Mr. Welch, and they are now trying to get the Central Pacific Railway to pay royalty.

A Slipped Locomotive.

It is reported that the other day a locomotive belonging to the Missouri Pacific slipped an eccentric at Wyandotte, Kan., and it appeared that the accident was more than the mechanical ability of that portion of the road was equal to meet successfully. Four different engineers tried to set the eccentric, but each in turn had to admit that he did not know exactly where was the right position for it on the driving shaft. The engine was eventually towed to the nearest roundhouse. Such an exhibition of ignorance would not be be tolerated on many roads, and fortunately few roads need to put up with it, for all engineers worth their salt make it a point to learn the proper location of eccentrics. The matter of learning how to set a slipped eccentric is so simple, that no man in charge of a locomotive has an excuse for being ignorant of it. Yet it is one of those simple matters that may lead to important consequences if a man is not prepared with the knowledge when it is required.

We once had to deal with an amusing case where ignorance about eccentrics detected in time an incompetent man who obtained a position as engineer by forged letters. The man had been hired during a busy time on the strength of apparently good recommendations. He made a few trips to learn the road, and was then sent out with an engine. After getting out twenty-five miles he telegraphed back that he had slipped an eccentric and wanted to know what to do. The answer was "Set the eccentric and go on with your train." Presently another dispatch was received at headquarters saying that eccentrics on both sides were slipped, and that the fire was dumped. The order was then sent to tow the engine home. On examination it was found that the engine had a broken valve yoke, and that in mistaking this for a slipped eccentric, the engineer had got the eccentrics all over the shaft. It was found afterwards that the man had never even fired an engine, but that he had considerable experience as a head brakeman, and had acquired sufficient familiarity with the handling of an engine while in that position to make him suppose that he could bloom out successfully as an engineer. He was in reality a good barber, and afterwards opened a shop in the town, where he tried by the exercise of monumental cheek to establish himself as an engineer. It was cases of this kind that induced master mechanics all over the country to refuse to hire engineers on letters of recommendation. Direct communication with the master mechanic formerly employing an engineer applying for work, is now usually resorted to, and very properly.

Mercury.

In these days of experiment and testing, most mechanical men have more or less to do with the liquid metal mercury, and to most men coming in contact with it the substance is a subject of curious study. It might be supposed that the nature of the metal would prevent it from being the subject of adulteration, yet that is not the case, for mercury is often found adulterated with tin, lead and other metals that can be readily dissolved in mercury without greatly affecting its fluidity. But manipulation of this kind to a greater or less extent spoils mercury for experimental purposes. The presence of foreign matter can readily be detected by putting a drop of the metal on a plate of glass and rolling it over the surface. Pure mercury leaves no trace, but rolls in spherical globules, but adulterated mercury forms elongated tears covered with a gray pellicle which adhere to the surface.

The capability of mercury to form amalgams with other metals at ordinary temperatures is said to have led to the ancient belief in the transmutation of metals, which did so much to advance the science of chemistry. The Chinese were familiar with mercury several centuries before the Christian era, and they had a belief that where cinnabar, the ore of mercury, was found on the surface, gold would be found beneath. Their views on the transformation of metals into ores and ores into metals, by heat and other means, took the form of a chemical doctrine about a century before Christ, and Gebir, the founder of the Arabian School of Chemistry, and others derived their ideas on the transmutation of metals into gold, and the belief in the immunity from death by use of the philosopher's stone from the Chinese chemists, who were manipulating mercury. Among all the metals which the alchemists experimented with, mercury was pre-eminent, and is believed to have been the real philosopher's stone. The belief in the virtue of this stone for prolonging life led to the use of mercury as a medicine. For some disorders it proved a remedy, but, in the ignorant way it was used, its application must have sent many people to premature graves. Chinese books say it takes two hundred years to produce cinnabar; in three hundred years it becomes lead; in two hundred years more it becomes silver, and then, by obtaining a transforming substance called "vapor of harmony," it becomes gold.

Mexican Treatment of Train Wreckers.

The Mexican authorities appear to be sound on the subject of train-wrecking. The prompt way they deal out justice to the ruffians who attempt wholesale murder by running railroad trains off the track might be imitated with good advantage by many communities in the United States. A recent dispatch from the City of Mexico says: "A week ago a train on the Mexican National road ran over and killed a Mexican near Patzcuano. Friends of the dead man undertook to retaliate and put a big rock on a curve. The engine of a passenger train struck it and the American engineer was injured and the Mexican fireman killed. A squad of Mexican gendarmes were sent with instructions to bring in every person suspected of any complicity whatever, or any information. Thirty-three arrests were made. An investigation resulted in the selection of three victims, and sentence was immediately passed, and shortly after sunrise yesterday morning they were marched to the scene of the disaster, stood up before an adobe wall and shot by a file of soldiers. The corpses lay for some time where they fell, as a warning against more train-wrecking, and were buried near the scene of the wreck."

A Wonderful Memory.

Mr. E. T. Jeffery, general manager of the Illinois Central Railroad, is noted among his friends and associates for the wonderful tenacity and accuracy of his memory. In giving evidence in the various suits brought against the company to deprive them of their rights in the lake front, Mr. Jeffery has given his evidence entirely without the aid of notes, although his answers had frequently to show intimacy with figures and minute details that few men could remember if they had nothing else to attend to. An illustration of his wonderful memory is frequently spoken of among the civil engineers. When he first became general superintendent he accompanied the engineer in charge of bridges over several divisions, embracing some 600 miles of track, minutely inspecting the bridges with a view of deciding on the extent of repairs and changes to be effected. The bridges were numerous, yet during subsequent consultations Mr. Jeffery proved that he remembered the identity and particulars of construction of every bridge they had examined.

Communications.

Extention Fronts.

Editors National Car and Locomotive Builder:

I have read with much interest the articles in recent numbers of your paper on the subject of extension fronts, and I desire to give the results of my observation and experience with engines that have these attachments, and with those that do not have them.

As regards the question of fuel-saving, the extension fronts can not be said to be economical. My own experience leads to the conclusion that engines with the extensions often burn more coal for the same work performed than they burned before the so-called improvement was made. But if I were asked whether we should return to the old types again, I would say no. The extension has some good qualities. Although it does not entirely prevent the throwing of cinders, it certainly does prevent the greater part of them from being thrown out, and thus far lessens the annoyance to trainmen and passengers. With the old diamond stacks, the engineers and firemen, whenever they ventured to put their heads out of the cab windows, or to open the front doors of cab in very hot weather, were sure to get their eyes filled with hot cinders.

It will be impossible to stop the throwing of cinders from locomotive stacks until you get a steady pull on the fire, which seems a difficult thing to accomplish with the present practice of using the exhaust steam to create draft. High nozzles do not appear to give such surprising results in saving fuel or in steaming qualities as did the old style low nozzles and lifting pipe, with diamond stack. Seeking for devices to prevent the throwing of dirt is futile as long as the primary cause of the trouble remains, namely, the jerky exhaust that makes draft.

When we get a well-proportioned boiler with suitable heating surface and grate area—not too much but just enough for the kind of fuel to be used—and get the feed water heated as hot as possible (perhaps with exhaust steam) and some method of making sufficient draft that will draw steadily on the fire (the draft need not be as strong as some people suppose) then, and not till then, may we reasonably expect to get rid of cinders and smoke, as well as considerable back pressure which still makes trouble on some locomotives.

This steady pull on the fire, if it could be accomplished (and that it can be I firmly believe) will also do away with extension fronts and all contrivances at present inside of them, placed there to make draft, burn coal and stop cinders. It is often noticed how little draft is needed on some engines to make plenty of steam, and if we would get down to work and heat the feed-water in the tender with exhaust steam, we might find some plan to make sufficient draft. All this would, of course, necessitate some radical changes in the construction of some parts of the locomotive, but it will come to this sooner or later. J. J. CLAIR.

PITTSBURGH, May, 1887.

Vestibule Cars Not a New Idea.

Editors National Car and Locomotive Builder:

The trite saying that there is "nothing new under the sun," was forcibly brought to my mind upon seeing the cut and description of the new Pullman vestibule car in your May issue. The new idea appears to be composed of several old ones that were applied some thirty or forty years ago to cars of the Camden & Amboy Railroad, the space between the cars being closed in by a covering. The details of the arrangement, as near as the writer is able to recall them, are as follows:

A wooden frame was made which conformed to the shape of the end of the car roof, and was held in position by spiral springs projecting out from the car more than half the distance or space between the cars when coupled together. To this frame, and also to end of cars, strong canvas was nailed. Wooden strips of the same length as the platform timbers were also secured to these timbers, with spiral springs, and with canvas nailed to the strips. When the cars were coupled, the frame and strips were held in close contact by means of the springs, which also permitted the necessary motion in curving. The canvas on end of roof dropped down at the sides so as to close them in. This is a part of the new idea which has been worked out in the so-called vestibule cars, although on the Camden & Amboy the closing in of the ends of the cars was not for the purpose of a passage way, but to keep out the dust (the cars having side doors but no end doors), the theory at that time being that the motion of the train raised the dust underneath the cars between the rails, and the idea was to hold it there and prevent it from getting into the windows. To further carry out this theory, canvas curtains were also suspended on the sides of the cars from the bottom of the sills to nearly the top of rails.

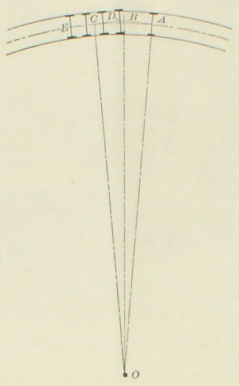
The Michigan Central Railroad Co. also had some coaches fitted with canvas between roofs and platforms as above described, but open at the sides, as their coaches had end doors. Canvas curtains were also suspended from the sills. Six or eight years ago, when the fast mail line was put on between New York and Chicago, the United States postal cars on that line were fitted with a vestibule connection similar to the Pullman plan, but there was no spring or canvas arrangement to make joint between the car ends. This passage way or connection was to prevent the mail clerks from being blown or thrown from the platforms while passing from car to car. These cars are still running on the New York Central road. From all this it would seem that the "new idea" is merely an old one more elaborately worked out. XXX.

To Find the Proper Length of Radius Bar.

Editors National Car and Locomotive Builder:

The proper length of radius bar, which Mr. Smith showed how to find graphically in your April number, may be obtained very simply by calculation.

In the accompanying figure, which represents the position of the wheels of a consolidation engine with two-wheeled truck, going round a curve, denote the length of rigid wheel base $D\,E$ by W; the proper length of radius bar, $B\,A$ by L; and the distance from the front driving axle to truck axle, $D\,B\,A$ by D. It is evident that the radius $O\,C$ drawn to the center of rigid wheel base is perpendicular to the center line $E\,D$ of wheel base. As Mr. Smith shows, the truck axle should be radial, hence we have the two right angled triangles $O\,B\,C$, $O\,B\,A$, in which radius $O\,C = O\,A$ and $O\,B$ is common. Hence $C\,B = C\,A$.



But $CB + BA = CD + DBA = \frac{1}{2}W + D$.

$$2\,BA = \tfrac{1}{2}W + D,$$

$$L = BA = \frac{\frac{1}{2}W + D}{2}.$$

That is, the proper length of radius bar may be found by adding to the distance between front driving axle and truck axle one-half the length of rigid wheel base and dividing the sum by 2.

This gives a length greater than is usually found. In a certain consolidation engine $W = 14$ ft. and $D = 7$ ft. 7 in. This would make $L = 7$ ft. $3\frac{1}{2}$ in. The actual length is 5 ft. 6 in. J. R. SLACK.

The Rotary Steam Snow Shovel.

Editors National Car and Locomotive Builder:

I have read several accounts of the performance of the Rotary Steam Snow Shovel on the Union Pacific Railroad last winter. These accounts are, I must confess, most convincing as to the successful working of the device, and if its durability is equal to its performance, it will undoubtedly meet a long felt want, not only in obviating serious snow blockades, but in reducing the cost of handling snow generally on railroad tracks. I have made inquiries as to the mechanism of this device, and as yet have been unable to find two master mechanics who are of the same opinion. If you could furnish a description in a future number of the CAR-BUILDER, sufficiently full to enable one to form a correct idea of the construction of the device, you would confer a favor on many of your readers. MASTER MECHANIC.

MINNESOTA, MAY 17.

The Chicago, Kansas & Nebraska Railway.

Editors National Car and Locomotive Builder:

The first regular passenger train on this line was started from St. Joseph, April 3, the following officers of the company being on the train: C. W. Fisher, general manager; W. I. Allen, division superintendent; J. H. Kirk, master mechanic; B. Bailey, train-master; A. Blauvelt, master car-builder; C. F. Jilson, treasurer; and H. F. Morris, auditor. These gentlemen were accompanied by Mr. George Royal, of the Nathan Manufacturing Co., of New York, upon invitation of Messrs. Allen and Kirk.

There are now about 315 miles of track laid. The trains run west from St. Joseph to Horton Junction, Kan., where the lines diverge, one going northwest and the other southwest. The main shops of the company are located at Horton, and are being built by Griffith & Grace, contractors, of Chicago. The machine shop is 100×200 ft., blacksmith shop, 125×75 ft., boiler shop, 125×75 ft., roundhouse, 42 stalls, with turn-table 68 ft. long. The car shops are 225×100, paint shop, 225×100, and storeroom, 75×100. The machinery for the shops has been ordered and will be ready between Sept. 1 and Dec. 31.

The Brooks Locomotive Works are filling one order for 50 locomotives for the road, 26 of which are now here. They are all the American 8-wheel type, with 18×24 cylinders, and weigh 42 tons each. The car equipment consists at present of 28 Pullman-built passenger cars, with 42 in. paper wheels and Midvale steel tires: 9 baggage, mail and express, 1,200 box and 700 flat cars. Contracts are also out for 800 box and 500 flats in addition to the above.

Nelson Station, Neb., is the present terminus of the northwest line. The southwest line will reach Harrington, Neb., about May 1. About 1,000 miles of track will be laid before the close of the present year. J. H. K.

HORTON, KAN., April, 1887.

New England Railroad Club.

The regular meeting of the club was held in Boston, May 11, President Lauder in the chair. The subjects discussed were:

AXLE BEARINGS, DUST-GUARDS AND LUBRICATION.

Mr. Lauder said that hot boxes were mainly caused by neglect. Imperfect dust guards were also a frequent cause, the excessive wear of bearings being largely due to sand and dust getting into the box. The Bemis box he thought excluded the dust very effectually, so much so that the wear of the journal was hardly appreciable.

Mr. Chamberlain, of the Boston & Albany, has put in service some Bemis axles with journals $3\frac{1}{2}$ diameter, and after running a year there was no perceptible wear.

Mr. Coney said that much of the trouble was due to a poor quality of oil. Sperm oil was the best. Thirty years ago he used no other kind, and there was little complaint about hot journals. The reason was that with sperm oil there was real lubrication, which was not the case with much of the stuff now used.

Mr. Lauder said that some roads used oil that cost less than 12 cents a gallon. Cheap oils might do for freight trains, but not for heavy passenger trains. The trouble with ordinary dust-guards was not so much the looseness around the journals, as in the imperfect fitting of the guard into the cavity provided for it.

Mr. Griggs, of the N. Y. & N. E., thought the heating was not all caused by dust. A good deal of it was due to the construction and fitting of the journals and brasses. The M. C. B. standard bearing was a costly one, and on his road was a continual source of annoyance. He could carry the same weight on a $3\frac{1}{4}$ in. journal, saddle-back box, with less oil and less wear.

Mr. Coney said the same oil, if kept continuously in the box, would wear out and cease to lubricate. Lead-lined bearings, he said, caused friction. He knew of no better composition than 1 lb. tin and $7\frac{1}{2}$ lbs. copper.

Mr. Chamberlain thought the friction between the journal and lead lining could not be very great. Some 700 lead-lined bearings that he had kept the mileage of averaged 33,000 miles before the lead was worn through so as to show the brass.

Some further discussion followed, in which the merits of sundry bearing metals were set forth, tests of oils, theories of lubrication, the most suitable diameter of journals, etc., but without developing any thing new.

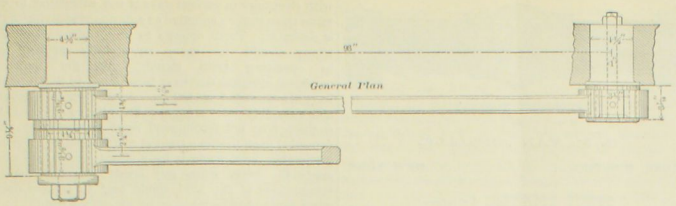
The club then adjourned to the second Wednesday in September.

Model of a Steel Car.

There has been for some time on exhibition in Chicago, a model of a steel passenger car, invented and patented by Mr. James Murison, of Minneapolis, and Mr. W. W. Green, of Chicago. The plan of construction is the bending of thin, wide bars of steel edgewise into a shape conforming to the outlines of a transverse section of the car, the bent bars forming a flattened arch. These steel bars or sections are set like the skeleton beams of an iron ship, and strongly bound together with sixteen $1\frac{1}{4}$ inch rods and braces. Pieces of iron pipe, through which the stay rods pass, are set between the sections, and the whole structure bound into a very strong unit. The outside is covered with corrugated iron, and the inside lined with galvanized iron and asbestos finishing. We understand that a company has been formed to construct some full size cars after this principle. The intention is to fill up all spaces between linings with mineral wool and make the cars entirely fireproof. Estimates have been made which show that a car can be built in this way which will be considerably stronger than first-class wooden cars, and yet be only two-thirds of their weight. Mr. Murison is a native of Montrose, Scotland, where in his youth he saw considerable iron ship building, and his invention of a steel car is a modification of the system pursued in designing iron ships.

The model has been examined by a great many leading railroad officers, and this departure in car construction is warmly spoken of by those best able to judge as to its merits.

IN his evidence before the Interstate Commission relating to the effect of the new law on railroad interests, Mr. E. C. Stubbs, general traffic manager of the Southern Pacific Railroad, said "it was a matter of public knowledge that the Canadian Pacific Railway did not have business enough to make a train load daily. Still, they were obliged to run trains, and it cost no more to haul them loaded than empty. They could take the freight at rates sufficient to pay for putting it on and off the cars." This theory of a loaded car being as cheap to haul as an empty one will be new to most railroad men. Mr. Stubbs deserves to have a position as Commmissioner of the Interstate law.

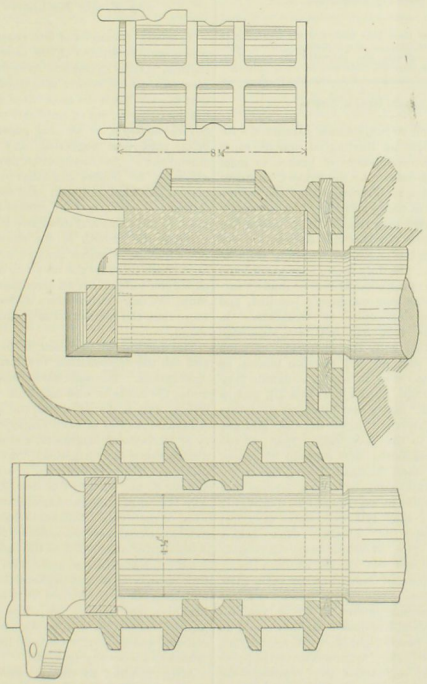


New Method of Fastening Crank Pin Collars.

Mr. T. B. Twombly, general master mechanic of the Chicago, Rock Island & Pacific Railway, uses solid ended side-rods on all the engines that have been built of late years, and his experience with them makes him enthusiastically in favor of this form of connection. He has lately applied the plan to his four-wheel switch engines, and our illustration shows the method he adopts to hold the collar on the forward pin where there is not room for a nut on the outside. As will be seen, he bores an inch hole through the pin, and inserts a bolt, whose head is the collar of the crank-pin. Engines with crank-pins bored in this way are doing the hardest switching work the road has to do, and they show no indication of weakness.

Effect of Throttling Steam in Locomotives.

One of the greatest difficulties met with by master mechanics and others who interest themselves in having their locomotives operated economically, is the unaccountable reluctance of locomotive runners to work with the throttle full open. It would be a fair estimate to say that three-fourths of the locomotives working in the United States to-day are operated with steam that is wire-drawn twenty per cent. below boiler pressure, by passing through a partly closed throttle. This is a case where locomotive designers, intelligent master mechanics and steam engineers have been for years struggling forward, and the man at the



The Thomas Car Brass and End Stop.

The engravings represent the journal box, brass and end-stop in use upon the East Tennessee, Virginia & Georgia road, of which Mr. W. H. Thomas is superintendent of motive power.

The journal box is M. C. B. standard in all respects, except the pockets and lugs upon inside of box, as shown in cuts. The axle is also of the same standard as to length and other dimensions, except that the journal is $4\frac{1}{4}\times8\frac{1}{4}$ inches and collarless. The end-thrust is taken up by the stop-block, which drops into the pocket or lugs upon side of box. This stop has been made of brass and also of cast iron with chilled faces, both of which have given perfect satisfaction. The brass fits top of box without interpolation of wedge, and has lugs at front and end which project over the stop-block and prevent its jumping out.

The top of brass is cut away, as shown in drawing, to lighten it, but ribs remain to give the necessary bearing upon top of box. Should brass, axle or wheel give out anywhere, any M. C. B. axle or brass and wedge would fit it without trouble. The device is being used on passenger equipment and engine tenders with perfect satisfaction, and is now being extended to freight equipment. It is not patented, but is free to the public.

throttle has been holding back, destroying all their work and neutralizing all their efforts. The best material that knowledge, skill and care could produce has been put into boilers, and designs to promote strength and to equalize strains have been introduced, so that very high pressure of steam on the boilers could be carried safely. Dry pipes, valves, steam pipes and induction passages have been enlarged, and every precaution taken to prevent the steam from meeting with needless obstruction in its passage from the boiler to the cylinders. Yet what avails it all? An engine with a boiler that carries steam of sufficient pressure to take a train along working at 6 inches cut-off with a full throttle is habitually worked in the 9-inch notch, and the steam pressure reduced by the throttle. The engine working in 6 inches would use about 21 pounds of steam per horse-power per hour, as shown by the indicator, and in 9 inches the steam used would be about 26 pounds per horse-power per hour. When additional quantity of steam used through cylinder condensation is estimated the proportion would not differ materially. About one additional pound of coal per horse-power per hour would be needed to generate the extra steam used on account of reducing the pressure by throttling. When we reflect that 500 horse-power is a common power developed by locomotives, we may readily estimate the effect that throttling the steam has upon the total coal consumption.

A well known road running out of Fort Wayne, Ind., had some little time ago a good illustration of the practical effects of throttling the steam of the locomotives. Two engineers were handling engines of the same class, and running on the same service. Engineer A was an old timer, a good, steady runner and highly careful man, but he believed in old ways and advocated the doctrine that the less pressure put in the steam chest the better, for every extra pound not needed to take the train along put so much useless pressure upon the back of the valve and thereby increased the friction. Engineer B was a young man, just as careful a runner as the other, but he believed in running with his throttle wide open. In practice it was found that Engineer A used about $40 worth more coal a month than Engineer B. The traveling engineer investigated the matter, and was perfectly satisfied as to the cause of difference in the performance of the two engines. He tried to get Engineer A to change his methods but failed. Then the assistant master mechanic took it up. The engineer held to his theory of keeping the friction down. But the undeniable fact was held up that he was constantly using more coal than the other engineer, and that he never dared to pass a water tank that the other engine habitually ran past. With this array of evidence he fell back upon the fireman, and insisted that the other man had the better fireman. The other fireman was at once given to him but with no better results, and then he held that the other was the better engine. Next day he was ordered to take the other engine, and see what he could do with it, but his coal consumption continued as high, and still he dared not run the water tank. Then the assistant master mechanic took Engineer A into his office and read a few pages about the use of steam from a well known book on locomotive engine running, and told him that he would do better to follow the method recommended in the book. With great reluctance and much misgiving, the plan of linking up as far as possible and running with a full throttle was tried, and after a month's working in this way, Engineer A came close to the record made by Engineer B, and has kept it up to the advantage of the company. It seems a pity that it is necessary to baby old enginemen in this way to perform an obvious duty, but the performance of the duty should be brought about in some way.

Growth of the Cable System for Street Cars.

The official report of the proceedings of the American Street Railway Association at Cincinnati in October last, has just been published. The report of the committee on the progress of cable motive power for street cars, and the discussion which followed, afford unmistakable evidence of the growth and successful operation of the system at various places, especially in Western cities. Not only are the lines already in operation doing well, but several new lines are in process of construction, as well as important extensions of old lines, all of which is a pretty decided indication that the working of cable lines in cities has ceased to be an experiment.

Mr. Chas. B. Holmes, president of the Chicago City Railway Co., set forth the superiority of the system as compared with horse-power in unqualified terms. It was making great progress in Chicago, a greatly increased number of passengers were carried last year, and property along the line had increased in value from 50 to 100 per cent. The company could not begin to do its present work with horse cars. The average speed was 10 miles an hour, but the power was under perfect control and could be adapted to any rate of speed less than this. There was no difficulty in handling snow. The cars were 21 feet long and weighed about 7,000 pounds. The open cars seated 50 passengers. The cost of operating a horse car was 25 cents a mile, while a cable car could be operated for $11\frac{1}{2}$ cents a mile.

In Kansas City more was doing in the way of extending the system than any where else. Two horse lines were being changed to cable, and there were three miles of double cable tracks already in operation. St. Louis has three miles of double track cable roads, and several miles are in course of construction in Omaha. In Philadelphia, the errors in the first construction of the cable lines have to a great extent been corrected, so that they now work satisfactorily and carry a great many people. The system is also making progress in Cincinnati, Los Angeles and other points, and has begun to get a foothold in New York. In San Francisco, as every body knows, it has got to be an old story.

There is, of course, considerable difference in the mechanical details of the different systems, but the operating tests will speedily determine which are the most effective and economical and most worthy to survive. The cable in some form is evidently the only method that is likely to supersede horses in propelling cars upon rails that have to be on a level with the street pavement. The power that propels must not ride on the car, but must be outside and independent of it, as much so as horses are. Traction machines will do upon clean rails above the level of the road.

Per Diem Charge for Car Service.

At the convention of the Car Accountants' Association, held at Atlanta, Ga., in April last, the committee on per diem charges presented the following report embodying sundry recommendations to be made to the General Time Convention at its next meeting. The recommendations were all adopted, the sixth being the only one that elicited much discussion:

REPORT.

Your committee, after ascertaining by an informal vote that all the members of the convention, with one or two exceptions, believe that a per diem charge, in some form, is absolutely necessary to correct the existing and growing evils of the present mileage system, and to bring about the much needed improvement in car service generally, have set ourselves diligently to the work of formulating a plan by which a per diem charge for car service can be most readily introduced on all roads of the United States and Canada, and which in its operations will rest upon the most equitable basis.

After exhaustive investigation and careful consideration of the different plans presented as to results obtainable, and their adaptability to the varying conditions of railway service, we have concluded that the mixed system of mileage and per diem is the best plan yet suggested, and being both feasible and equitable will produce the most satisfactory results. We therefore recommend as follows:

1. That the present mileage rate be reduced to one-half cent per mile, and that a per diem rate of fifteen cents per day be added.
2. Rate on four-wheel cars to be one-quarter cent per mile and 7½ cents per day.
3. Per diem charge to begin on the date of delivery, but no per diem charge shall be paid on any cars received and delivered on the same date.
4. Days to be counted from one date to another, *i. e.*: A car received on April 1 and delivered on April 10, nine days.
5. Line cars shall not be subject to per diem charge except on roads not in the line. When desirable, special arrangements may be made with line managers to hold line cars on any road exempt from the per diem charge.
6. Per diem rate not to be allowed on cars of private car companies.
7. Per diem on cars switched by one road for another for the purpose of receiving or discharging lading shall be paid by the road for which the switching is done.
8. Per diem should be paid on cars in shops, and on cars destroyed, until date of notice to owners authorizing bill for settlement.
9. The adoption of a junction report to owners of foreign cars which shall show the numbers of cars delivered connections, with date of receipt and the number of days for which the per diem rate will be allowed.

Large and Small Wheels.

A correspondent requests a solution of the following queries:

What are the advantages, if any, of a 42-inch wheel over 33-inch, as respects draft power and journal friction when running either upon level or rising grades, the speed, weight of load and condition of track being the same? Also, which of the two sizes of wheels will run down a given grade by gravity the quickest?

These questions have been discussed quite often at the meetings of the Car-Builders' Association with no result but to develop contrariety of opinion, uncertainty and bewilderment. There would seem to be but one way of definitely settling problems like these, and that is by carefully-conducted tests. So far as we know, no such tests have as yet been made.

The general impression is that upon level track large wheels tax the draft power less than small ones, but we have never seen the difference estimated at more than four or five per cent., the difference being attributed to the greater leverage or semi-diameter of the large wheels, and less journal friction from the fact that 33-inch wheels make 27 per cent. more revolutions in running a given distance. Inasmuch as actual friction is not at all affected by velocity or the area of bearing surfaces in contact, its retarding effect would be the same for the two sizes of wheels; but the smaller journals would be more liable to heat because the weight upon them is concentrated on a smaller surface. The large wheels certainly get over obstructions more easily and communicate less jar to the car body in passing frogs, switches and inequalities of track, and the car is, therefore, said to ride easier.

Assuming that big wheels require less draft power on level track than little wheels—and it is a mere assumption—it is easy to argue that the big wheels have a like advantage in going up grades. Perhaps they do, but we would like to see it practically demonstrated. The law of gravitation is the same everywhere, and is not affected by the sizes of wheels. The weight of the entire car has to be lifted from the foot of the grade to the top, and if the power which propels the wheels can get a single pound of the weight up there without lifting it in some way, it necessarily follows that it is possible to run a whole car or any number of cars up a grade without any power at all.

As to the comparative speed of a large and small wheel running down a grade by gravity, assuming the tracks on which they run to be perfectly smooth, the chances are that it would be a scrub race. If either wheel came out ahead it would most likely be the big one, and the only reason for it would be its greater weight. Some years ago some experiments were made on the Lake Shore road, we believe, for the purpose of testing the matter. Two passenger coaches, having respectively 42 and 33 inch wheels, were run down an incline, and it was said that the big wheels ran away from the little ones. The coaches were supposed to be of the same weight, except the additional weight of the large wheels, and little obstructions were placed on the tracks to register the speed. The obstructions would, of course, favor the large wheels, which would mount over them more easily than the small wheels would.

NATIONAL CAR LOCOMOTIVE BUILDER

PUBLISHED MONTHLY
BY
R. M. VAN ARSDALE,
MORSE BUILDING.....NEW YORK.

JAMES GILLET, ANGUS SINCLAIR, } Editors.

JUNE, 1887.

Subscription.—$1.00 *a year for the United States and Canada; $1.50 a year to Foreign Countries embraced in Universal Postal Union*

EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *The editorial department will contain our own views and opinions; and the rest of the reading matter, aside from advertisements, will be such as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock, construction and management, and kindred topics, by those who are practically acquainted with these subjects, are especially desired. Also early notices of changes in railroad officers, organizations and names of companies.*

Special Notice.—*As the* CAR AND LOCOMOTIVE BUILDER *is printed and ready for mailing on the last day of the month, advertisements, correspondence, etc., intended for insertion, must be received not later than the 25th day of each month.*

The Burlington Brake Tests.

One of the most striking circumstances connected with the recent brake tests held at Burlington was the rapid progress displayed in the development of brakes to meet the difficult conditions laid down by the Brake Committee and to fulfill the conflicting requirements that the severe tests have demonstrated as being necessary in a successful freight train brake for very long trains. It is only a few short years since the Master Car-Builders' Association was put on record as favoring buffer brakes as being the best adapted for freight cars. The July brake tests annihilated all hope that independent brakes could ever be made a success on the kind of trains now commonly handled, and they also proved the existence of weaknesses in the elastic vapor brakes that had not been suspected by the men most familiar with the operating of such brakes. It was found that air and vacuum brakes, as then constructed, were too slow in action to handle long trains so that stops could be made as quickly and as smoothly as was desired. Since the July tests invention has been laboring to overcome these defects, and the results were exhibited in the May trials. Most of the contestants evidently concluded that rapidity of action, so that imposing stops could be made during the trials, was of greater importance than producing apparatus that would be absolutely certain at all times and thoroughly durable in service, and they fell back upon electrical appliances as the means of putting their brakes quickly into action. The Westinghouse Automatic Air Brake Company, and the Eames Vacuum Brake Company effected important improvements upon their brakes that make them materially more efficient than they were for handling brakes by air or vacuum alone; but they have both also shown what they could do by the aid of electricity, making the electrical appliances, however, merely supplementary to the automatic apparatus. Without electrical appliances the Westinghouse brake can now stop a train of fifty cars in about half the distance that was required when the July trials were made, and the Eames brake can do the stopping in about two-thirds of the distance they used before, and the stops are short enough for all practical purposes and quicker than sensible railroad men will care to have their freight trains stopped.

It appears to us that the general verdict of the Burlington tests will be, that railroad companies have no longer any excuse for refusing to equip their freight trains with an automatic brake. It is certain that either of the brakes mentioned with air or vacuum alone will control the longest freight train with ease. We doubt, however, if many railroad men would want to have electrical apparatus introduced as a necessary or even emergency attachment of an automatic brake. Emergency attachments are not popular with railroad men, and very few people believe that electrical attachments to train brakes would be worth maintaining. The experience of the tests themselves seemed to point to electrical apparatus as being too unreliable for braking purposes.

The weather was excellent, the apparatus was all new and in skillful hands, yet there was trouble with most of the electrical appliances. Before railroad companies can afford to depend upon brakes applied by electricity the force must be as reliable as the automatic features of an air brake now are. The experience that railroad men have with electricity in various ways is not calculated to convince them that its adoption as a means of applying brakes is desirable. There appears to be no place where electricity should be more successfully applied than in operating train signals, yet the numerous persistent attempts that have been made in this direction have always ended in failure. A force which is not reliable enough to carry a message from the conductor to the engineer does not recommend itself as worthy of being depended upon to stop a train at a draw-bridge. The suggestion has been made to use a closed circuit that would apply the brake when any break happened, but an arrangement of the kind would lead to endless delays when cars had to be taken on or put off the train.

It will be a long time before many freight trains are operated under conditions similar to the requirements of the last Burlington tests. It was right and proper for the committee to require that all the brakes entered for the test should be used handling a very long train, but the trains of that size to be found fully equipped with automatic brakes will be rare for many years. The common way of handling freight trains with automatic brakes now is to place in the front of the train a few cars having the brake, and control the train by them. A brake that can be handled most successfully in this way is the brake wanted. In deciding on the freight car brake best adapted to their wants, railroad companies must not lose sight of the important fact, that their brake should be interchangeable with those of other roads.

Proposed New Constitution for the American Railway Master Mechanics' Association.

On several occasions of late years it has been found that papers were submitted at the meetings of the American Railway Master Mechanics' Association by associate members and others, which contained objectionable features that in some cases the association did not feel justified in indorsing by the act of publication in the annual report. Several methods of keeping papers of this nature from being read were suggested, and among them was an amendment to the constitution providing for direct supervision of all papers submitted to the association. Some plan of this kind met with most favor, and last year a committee was appointed to amend the constitution and by-laws, to meet this and other requirements that had arisen through the growth of the association. The proposed amendments, or rather the new constitution and by-laws, as recommended by the majority of the committee, so far as we can judge from an examination of a draft of the same, are more radical than we had reason to expect, and more than the requirements of progress would seem to demand.

The first change proposed is to abandon "American," and call the organization the Railway Master Mechanics' Association. The association has prospered fairly well under the name it now has, and we do not see the least reason why it should make the proposed change. The American Society of Civil Engineers, the American Society of Mechanical Engineers, and numerous other societies distinguished as "American," do not seem to languish under the weight of the name or anything which it implies, and we do not see why the members of the American Railway Master Mechanics' Association should drop the first word of their title. The name does not appear in the past to have offered a serious obstacle to Canadian, Mexican or other master mechanics on the American continent from joining the association, and we do not believe that the future prosperity of the organization would be jeopardized by letting the name remain as it is; and if any one feels that his tastes, dignity, prejudice or self-esteem would be hurt by connection with an American Railway Master Mechanics' Association, we believe he would be cordially permitted to keep away from it.

After deciding to change the name, the committee throw aside the old constitution and begin anew. They do not propose to amend the constitution; they propose to substitute a new one root and branch. They propose adding a new class of members to the association to be called "Junior." We do not object to this proposal in itself, as we consider it is calculated to increase the interest in the association, but we think it would be unwise to adopt the requirements recommended for junior members. They are to consist of chief draftsmen and junior employés in railroad service who have taken successfully an engineering course in an acknowledged college or technical school. We have the very highest opinion of technical school graduates, and are persuaded that their presence would lend strength to the association, but there are many bright young men in railroad service who have studied at evening schools, and in other ways have acquired scientific and mechanical training second to nothing imparted at an "acknowledged college or technical school," and we do not see any reason why such youths with self helpful habits should be excluded from the association. The right way would be to make the association the judge of a youth's fitness for admittance as a junior member.

By the new constitution, the president of the association is made eligible for election for two terms of office, but no more. It is proposed to make the chief officer perform a considerable part of the duties now performed by the secretary. The president, vice-president, and treasurer would

be elected by the association as at present, but the secretary would be selected by the executive committee, as in the Master Car-Builders' Association. The executive committee would be a very powerful body, and would practically have the entire management of the association and its business. We think there are numerous details about the management of the business connected with an association of this kind that can wisely be left to the care of the executive committee, but we think it is possible to make the executive committee more important than the body from which their power emanates. The American Railway Master Mechanics' Association has always been exceptionally free from the petty tyranny of clique management, and we think the members ought to be careful about permitting constitutional changes that may reduce the control the association has always exercised over its own affairs.

We understand that Secretary Setchel, who is a member of the committee appointedto amend the constitution, will submit a minority report.

A Perplexing and Anomalous Law.

The interstate commerce law may justly be classed among the anomalies of legislation. Aside from its general vagueness and obscurity in meaning, so perplexing to railroad men and legal experts who have labored to give to it a coherent interpretation, it contains a clause which practically invalidates one of its most important sections by authorizing a suspension of the requirements of such section as soon as the law as a whole takes effect. Worse than this even. The suspension, instead of being absolute, is only partial and temporary by being limited to a certain number of days or months and to certain roads or sections of the country ; or it may constructively be made general and continuous at the discretion of a commission composed of five persons. And furthermore, the final test as to the real meaning and scope of the law, owing to the conflict of individual opinion, must await the trial of issues in the courts, while the vast business interests of the country are in the meantime involved in suspense and uncertainty. What the ultimate outcome is to be is to a great extent a matter of conjecture. The long and short haul section as it stands, when considered as the product of the concentrated legislative wisdom of the land, designed to affect directly the operation of 130,000 miles of railroad and the commercial and transportation interests of a vast population, is one of the most amazing specimens of enlightened lawmaking extant. The obvious intent of the section is to lay down a specific and compulsory rule, but what the rule is can only be determined by individual opinion, which practically and in a legal sense is no determination at all.

In view of the fact that this enactment derives its validity from the votes of a certain number of Congressmen, leaving the great business community to deal with its ambiguities and entanglements in the face of dire penalties if they are not dealt with as their authors intended they should be, it would seem to be incumbent upon these Solons to step forward and help interpret their own bantling. Let them get together informally and give us their views. The intent of the makers of a law, so far as it can be ascertained, is held to be the proper criterion for its interpretation. It would be a reflection upon the legislative wisdom to presume that the framers of a law of such importance as this one did not know exactly what they were doing or what they were trying to do when they passed it.

The obnoxious fourth section seems to have been inserted under the impression that the roads would reduce short-haul rates rather than long-haul rates ; but with a sort of mental reservation that if this impression should turn out to be a mistaken one there would be no harm in trying the experiment. If too much hardship should ensue, or too much injustice be inflicted in any particular case, the commission could mollify it by granting an indulgence for the time being, or perhaps indefinitely in extreme cases. This feature of the working of the law is now in full operation, but how long it will last the railroad regulating soothsayers can best tell.

Dangers of Double-Heading.

Nearly all railroad superintendents and master mechanics entertain a strong but rational prejudice against the practice of putting more than one locomotive to pulling a train, and double-heading is consequently little resorted to. When unusually heavy trains or bad weather makes double-heading an unavoidable necessity in the case of passenger trains, every possible precaution should be taken against accidents that are apt to arise through the engineers on the separate engines not acting together. It is quite a common practice when a second engine is needed for a passenger train, to take as an assistant a freight engine that has no air attachments and place it in the front. This practice is full of danger. We will cite two cases that have come to our knowledge, and which are of recent occurrence. The A. & B. road was considerably troubled with snow last winter, and it became a common practice to put double-headers on passenger trains, a freight engine without air being invariably used as the helper. One stormy night a train was pushing along, many deep snow drifts having to be worked through. At the spots where the track was fairly clear of snow, both engineers agreed in doing their best to keep up a high speed that would force them through the next snow obstruction, which never was long in coming. While they were tearing along on one of these clear spots, the right hand forward driving axle of the forward engine broke close to the hub of the wheel, and the driving-wheel went spinning into the country. The released side-rod came round like an irresistible flail and smashed the running board and side of the cab, throwing the engineer bruised and bleeding on the foot-board. Though badly injured, he jumped up, found the whistle lever and called for brakes. But the engineer of the train engine thought the call meant that they were approaching an unusually deep snow-drift, and he dropped his reverse lever a notch, and opened the throttle wide. The call for brakes was instantly repeated, and after a time understood, but the train ran over a mile from the point where the wheel was lost before it was stopped. Fortunately the accident did not derail the engine, and the misunderstanding of the whistle signal led to no serious consequences, but it is easy to perceive how the mistake might have resulted fatally.

A case somewhat similar in some respects that happened on the B. & C. road, had not such a fortunate termination. Two engines were pulling a passenger train along, also in a snow-stormy day. On rounding a curve the engineer of the leading engine perceived danger ahead, whistled for brakes, and reversed his engine. The second engineer, instead of promptly obeying the signal, looked out to see what was the matter, even without shutting off steam. The delay was fatal ; for before the tardily applied brakes had time materially to reduce the speed, the train crashed into the hind end of a stalled freight train, killing a stock man who was asleep in the way car.

The brakes of a train ought to be handled by the front locomotive, and under no circumstances should a leading engine be without the means of controlling the brakes. Some roads are not in a position to put an air pump and its connections on each freight engine, but there is no road that could not put air pipe connections from the pilot to the back of the tender of every locomotive likely to be put on a passenger train. When an engine is thus equipped, the regular passenger engine can be put in front and the helper next to the train. This is an improvement which no railroad company has any justification in neglecting, and it is to be hoped that the coming summer will see material progress made toward ending the most imminent danger connected with the practice of double-heading passenger trains.

A Brief Retrospect.

The operation of the interstate commerce law in its present stage of development, suggests that a brief retrospect of the tendencies of railroad management and practice for years past to bring about federal interference in rates and traffic, may not be out of place, as showing the causes which have operated to make such interference inevitable.

In 1865 we had only 35,000 miles of railroad in operation. The roads constituting this mileage were built almost entirely to meet the actual and not the anticipated needs of transportation, and their management was mainly in accordance with a sound, well considered and cautious policy. A national law for their regulation was regarded only as a remote possibility. The expansion era began in the year above named. Railroads were projected everywhere, in fields old and new, on a basis of credit and credulity, until in 1870 the aggregate mileage had increased to 53,000, and in 1880 to 93,000. About 1869-70, the older roads, in their struggle for business with the new facilities, undertook for the first time to compete with lake, canal and river lines for long-haul low class freights. The competitive demands, also, of the great trade centers became in the meantime more importunate and pressing. The result was an increase in the capacity of the water lines and a steady decline in the rates by rail. There was a wild clamor everywhere for new roads, and the mad energy produced, as might have been expected, a horde of eager incompetents to direct the enterprises. Managers, presidents, engineers and directors were to a very great extent unfitted to adapt the new investments to the expected traffic. They were bent upon making the enterprises pay, however, or seem to pay, something on the outlay.

This unprecedented activity, followed as it was by a period of general bankruptcy and foreclosures, necessarily led to unjust discriminations between localities and between shippers. An unwise and reckless application of the wholesale and retail principle as recognized in mercantile dealings was made in railroad transportation, rate compacts were made that were binding only so long as it was more profitable to keep than to break them, a mutual distrust was engendered between managers of rival lines, there were violent fluctuations in rates, evasions, rebates, war to the knife, adjustments, peace-makings, and a general lack of stability in conducting the great and increasing transportation business of the country. This contention, rivalry and hurly-burly, continued as it was year after year, could have no other effect than to implant in the public mind a feeling inimical, not so much to railroads as to their methods of dealing with their patrons and with each other. The people at large needed instruction in regard to the intricacies of freight traffic, but railroading is still an occult science to a vast number of passably intelligent and well meaning persons whose controlling idea is that rates for the same kinds of freigh should be fixed on the basis of mileage, and should be uniform on all roads irrespective of locality or other conditions. This seems to them to be all that is needed to place shippers on a footing of perfect equality.

This prevailing delusion, in connection with the abuses above cited, and the proneness of railroad officials to lose sight to a great extent of the radical distinction between railroads as common carriers, and private unchartered mercantile and manufacturering enterprises, has led to national interference and the enactment of the anomalous and ill-considered national law which has for months puzzled the brains of lawyers, judges and railroad officials all over the land. Congressional interstate interference has been impending for the last ten years, and in view of all the provocations and inducements, it is only a wonder that it has been deferred so long.

We do not think a national supervision of railroads is necessarily an evil. Everything depends upon the limitations of such a power and the way it is used. The present law with all its apparent imperfections may turn out to be a blessing in disguise, but the present outlook in that direction is not promising. The important question is whether such a law is to be perfected piecemeal and as an experiment, at the cost of a world of trouble resulting from its own crudeness, or by an intelligent comprehension at the outset of the problem to be dealt with.

Preventable Accidents not Necessarily Crimes.

The Massachusetts Railroad Commissioners, in their report on the Bussey Bridge disaster, say that "a preventable accident is a crime." This is a pretty broad assertion when made without qualification. A crime is the willful doing of what is forbidden by law, or the willful omission of a duty imposed by authority. A very large proportion of the innumerable accidents that are constantly occurring is shown by investigation to have been preventable had the necessary precautions been taken to guard against them. A failure to take such precaution is usually from lack of judgment and with no malicious intent. The neglect in such case may be highly censurable, but it can hardly be considered criminal, except by a stretch of construction that has its degrees and limits. If all preventable accidents are crimes, then there is a host of criminals in the community who are not only unconvicted and unpunished, but unconscious of their criminality.

The capacity of a bridge or any other structure to resist the strains to which it is subjected depends upon human skill and judgment, and these are imperfect and fallible and ever will be. Laws may be enacted to punish people for these inherent weaknesses when they are the cause of accidents, but such laws will not cure the evil or make human nature other than it is. Punishment may induce greater precaution, but it will never prevent honest mistakes and what are called errors of the head, nor can every human agency be superseded by unfailing mechanical devices.

When obstructions are maliciously placed on a railroad track the criminal culpability is clear. But when a signal is not displayed, an order not delivered, or a switch left open from sheer lapse of memory, the culpability is equally clear but not the criminality, for the reason that there is no criminal intent. If penalties are inflicted to deter others from being thoughtless, forgetful and absent minded, they should be modified in their severity as compared with punishments due to acts involving downright moral turpitude. This discrimination is recognized by almost everybody as being just and right, and always will be so recognized, no matter how vociferously it may be asserted, when a first-class railroad crash happens, that a preventable accident is a crime.

The Traveling Engineer.

Of late years many master mechanics have been forced to the conclusion, by investigations which could not be gainsaid, that a great deal of heat has been wasted by engineers working their engines in a careless wasteful way, and by firemen using coal as if the material cost nothing. The most successful method adopted to close up the leaks arising from these sources has been the appointing of live progressive men as traveling engineers, men who have interested themselves in doing their work well, and are competent to instruct old engine runners and young firemen. Many have admitted, after appointments of this kind have been made, that the traveling engineer's pay was one of the best investments the road ever entered into. But to make the work of a traveling engineer a success, it is necessary that he should have ample authority over the men, and that his orders and actions should be firmly sustained by master mechanics and superintendents. There have been many failures with traveling engineers. Appoint the oldest runner on the road, or the loudest talker or the man most popular with the other engineers, without strict consideration of his fitness, as is often done, and the chances are that the company will reap no benefit from his services. To make a success, a traveling engineer must be intelligent enough to be the master of his own business, and that will compel the respect of the men he is going to control and influence. He must have clear ideas of how firing should be done to make the greatest quantity of steam out of a given weight

of coal, he must know how steam ought to be used in the cylinder to convert the greatest part of the heat into the mechanical work of taking a train over the road, and he must understand all the mechanism of the train, the engine and the engine attachments so thoroughly that he can explain any disorder. When an injector declines to work, the traveling engineer, if he happens to be present, should, by showing what is probably wrong, convince all concerned that he understands his business. His knowledge ought to make him the guide, counsellor and friend of trainmen respecting the disorders of lubricators air pumps, triple valves and derangements of other mechanism that appear strange, mysterious and unaccountable to the untrained man. With a traveling engineer of this character, it is the blame of his superiors if he does not effect important reduction in operating expenses.

Prevent Boiler Accidents.

In a recent issue of that valuable and ever interesting journal, *The Locomotive*, a summary is given of boiler explosions for the year 1886, which shows the cases reported to be 185 explosions in this country during the year, 22 of them having been locomotives. Attention is directed to the fact that 12 per cent. of the whole number happened to locomotives, a class of boilers popularly supposed to be exceptionally free from disasters of this kind. As locomotive boilers are largely in excess of others in point of numbers, we do not think the record of explosions for 1886 reflects much on the men having charge of this kind of boiler, but it conveys the lesson that only constant care and unsleeping vigilance can prevent this destructive and disasterous form of accident. The tendency of the day is strongly towards increase of boiler pressure, and added tension is not always accompanied by increase of strength. Those interested do not always bear the fact in mind that deteriorating agencies are much more dangerous to a highly pressed boiler than to one which carries a moderate pressure of steam. There are many old boilers in service carrying high pressures that would be found to have a very low margin of safety if they were properly examined. In watching the operations of the workmen in a railroad boiler shop some few weeks ago, we noticed a man who was enlarging stay-bolt holes break his tap. He said it was the third tap that he had broken on that boiler, and that the shell was as hard as tool steel. When a boiler gets in such a condition, it is time it was condemned or annealed, and there are many boilers running just in that state.

But the urgent need in railroad service is thorough and systematic inspection of stay-bolts by competent and responsible men. We lately heard two railroad men from different sections of the country talking about boilers, and each was giving his experience of engines coming into the shop with broken stay-bolts. Each had to tell of an engine coming in from an out station with more than a hundred broken stay-bolts. In one of the cases the engine was regularly inspected by a boiler maker. The true and effectual remedy for the detection of broken stay-bolts is drilling through the outside sheet. We can understand the force of the objection raised by a master mechanic to the practice, that it caused annoyance from leakage when a stay-bolt broke, but it is better to endure a few of these minor annoyances than the supreme trouble of an exploded boiler, and the sacrifice of several lives. When fire-boxes were all small, it was a comparatively easy matter to prevent serious accidents resulting from broken stay-bolts, but every square foot added to the flat surface calls for increased precautions. The master mechanic who neglects to meet the altered conditions of locomotive construction in providing against boiler accidents is doing injustice to the company and to all the company's employés.

Liquid Fuel for Locomotives.

A locomotive has lately been exhibited in Meadville, Pa., which burns gas as fuel made from petroleum, and the matter has been written and spoken of as if it were a great novelty. Surely the reading world, at least that portion which reads railroad and mechanical journals, has not already forgotten the hopes, promises, successes and failures of the Holland locomotive of happy memory. There is really no difficulty in burning petroleum as a fuel in a locomotive furnace. The only reason why petroleum is not extensively employed is that coal is cheaper. In Russia liquid fuel is extensively used for locomotive purposes, and its use is extending for a great many purposes. The following is from a recent copy of *Engineering* :

Last autumn the Russian Government adopted a new type of liquid fuel furnace, invented by Lieutenant Pashinin, for the torpedo boat Lerke. Experimental trips before the close of the season demonstrated the success of the new invention, but no details were published as to the results obtained. Since then the same furnace has been fitted to two steamers built by the firm of Butz & Co., St. Petersburg, for service on the River Oxus. A trial with these took place a few days ago, in the presence of a large number of influential personages, and, according to the *Novoe Vremya*, was again a complete success. The trial demonstrated that 1 lb. of petroleum refuse evaporated 15.6 lbs. of water, or 2¼ times more than coal. During the consumption of the liquid fuel, a sheet of white paper was held at a height of 14 in. above the funnel, and at the end was neither discolored nor marked with traces of soot. Compared with other systems in use in Russia, the *Novoe Vremya* says that whereas the proportion between the expenditure of coal and oil refuse is 2 to 3, the proportion in the new invention is 1 to 2¼. Probably further practice will lead to better results than even these, as at present, owing to the low price of liquid fuel, Russian engineers have no inducements to be economical. At Baku the price per ton is often as low as 4d., and the question of economy is never thought of at all. On the Volga, however, the case is different, and the further from Baku the more careful the engineers are found to be. It is expected that Pashinin's furnace will be applied this year to a large number of torpedo boats in the Black Sea, where the supply of liquid fuel is now plentiful.

Disputed Crossings.

SURELY there is a law in every State to regulate matters in dispute that arise when one railroad company wishes to cross another road. That being presumably the case, the common spectacle of one company putting locomotives, cars and other obstacles in the way to prevent an extending line from crossing, and reinforcing this obstruction with crowds of well stimulated laborers, is not an edifying sight. The obstructed company does not give up the struggle quietly, and a conflict often goes on for days with much wordy war, some bloodshed and an enormous expenditure of profanity on both sides. When the whole region gets thoroughly disgusted with the performance, and the Sheriff begins to talk of making wholesale arrests, the companies settle the dispute and the intruding road crosses at the point settled on at first. It would be hard to enumerate all the roads that have taken their share in this lawless and stupid kind of proceedings, but the latest examples are the Pennsylvania and the Baltimore & Ohio Railroad Companies. When employés of these companies strike and resort to lawless means to gain their ends, the companies are ready enough to denounce the proceedings and call on the officers of the law to punish the offenders, but they do not seem to reflect that they themselves are very ready to show an example in violating order, law and common sense. What is badly wanted as an example is the sending of a general manager or two to the states prison as instigators of riot.

Improvement in Locomotive Grates.

The mechanical department of the East Tennessee, Virginia & Georgia Railway are experimenting with a new smoke preventing device for their locomotives. They use table grates with diagonal slots or openings ½ × 3 inches, and 34 such openings in each grate. The grate next to the fire-box door is made stationary, and a back is cast upon it which is slotted. The back damper is kept shut and the front one open when running. The air passes in over the back dead grate and gets partly heated before reaching the fire, the supply by that opening being provided to make up for the restricted supply that passes through the contracted grate openings. The arrangement works well as a smoke-preventer and saves fuel, the narrow openings in the grates preventing the waste of coal that is usually caused by the fine coal falling into the ash-pan. When the grates are shaken the drumming sound that follows the shaking of grates with wide openings is not heard, which shows that a finer admixture of the gases of combustion goes on. Another incidental advantage of the arrangement is that lighter firing can be practiced than is possible with the ordinary way of admitting air through wide grates.

PREDICTIONS are made in certain quarters that the new railroad (main track) mileage of the current year will reach a figure somewhere between 10,000 and 15,000 miles. The greatest length of new track constructed in any one year was in 1882, when it reached 11,568 miles. The reported new track laid during the four months previous to May 1 of the present year, as computed by two prominent railroad journals, varies from 967 to 1,564 miles—a difference of nearly 600 miles—which seems to indicate that either one or both of these authorities have based their estimates to some extent upon incorrect or imperfect returns. Assuming the truth to be a medium between these extremes, the new mileage completed on the 1st of May would be 1,265 miles, leaving 8,735 miles to be added within the next eight months in order to make a total of 10,000 miles (the minimum estimate), or an average of nearly 1,100 miles per month.

This looks like pretty lively work for the rest of the year. Before mileage can be reckoned the rails must be laid. This, however, is not a slow process when the grading and rails are both ready. It is reported that grading is going on rapidly, and that some 3,000 miles at the West and South are already in readiness for the track.

THE Pennsylvania Railroad Co. is substituting stone bridges for iron wherever practicable. Sixteen stone bridges have been built on its lines within the last two years, and a number of other very important ones are now under construction or about to be commenced. As an example of the ultimate economy of so doing the Conemaugh viaduct on the west slope of the Alleghanies is cited. This stone structure was built in 1833, and has not cost $50 since then for repairs.

THE Philadelphia & Reading Railroad Company is having built at its shops 100 iron tubular cars. These are said to weigh less than wooden cars of the same dimensions, and to have a carrying capacity of 60,000 pounds.

THE Eames Vacuum Brake Co. have issued a new descriptive and illustrated catalogue showing the details of construction and operation of the Eames freight brake, with special reference to the train equipped with it for trial at the Burlington tests last month. The engravings consist of ten plates unsurpassed in the excellence of their execution, and the descriptions are so clear and free from unnecessary amplification that the working of the brake can be easily understood. The illustrations include a floating fulcrum lever arrangement for automatically adapting the braking power to weight of car load; also a muffler for disposing of the exhaust steam without affecting the draft, dampening the fire or driving the smoke into the cab. An auxiliary electric valve attachment is also shown, which increases the effectiveness of the brake. The application of the Eames driver brake is also illustrated and described.

MESSRS. GOODELL & WATERS, of Philadelphia, have just issued a new descriptive and illustrated catalogue of their Planing Machines, embracing the several kinds suited for fine cabinet work to heavy timber dressing. The catalogue is designed for the large number of their customers who do not use sash, door and blind machinery, but only want a list of planers. All these machines are built to standard gauges and templates, making like parts of machines of the same class interchangeable. The firm make a specialty of planers, and are making patterns for several new ones with important improvements.

THE OFFICIAL RAILWAY LIST for 1887 has just been published by the Railway Purchasing Agent Co., of Chicago. The volume is uniform in size and binding with previous issues, and is convenient for the desk or pocket. It contains a corrected list of officers of the railways in North America, also an index of names of railway officials contained in the book, illustrations of standards adopted by the Master Car-Builders' Association and other useful information. Price, $2.

THE PHOSPHOR-BRONZE SMELTING CO., 512 Arch street, Philadelphia, have issued a circular announcing that their new foundry is now in successful operation, and fully equipped for the production of all kinds of phosphor-bronze castings, in green and dry sand or loam. The company make a specialty of car and locomotive bearings, heavy gearing, hydraulic, marine, rolling mill, mining and engine castings.

MR. H. A. Little, who has been so long and so well known to most railroad officers, has been appointed representative of the Safety Car-heating and Lighting Company, of No. 160 Broadway, New York.

Our Directory.

We note the following changes since our last issue. Our readers will do us a great favor by giving us prompt notice of any changes that may come to their knowledge or of any errors that may be noticed in our list :

Central of Georgia.—W. P. Savage has been appointed Superintendent to fill the vacancy caused by the death of F. M. Fonda.

East Tennessee, Virginia & Georgia.—Peyton Randolph has been appointed Assistant General Manager, with office at Washington, D. C., and C. H. Hudson has been appointed General Superintendent, with office at Knoxville, Tenn.

Hannibal & St. Joseph.—I. N. Wilbur has been appointed Division Master Mechanic.

Housatonic.—Wm. H. Stevenson (late of the New York, New Haven & Hartford) has been appointed Vice-President and General Manager.

Kansas City, St. Joseph & Council Bluffs.—G. N. Nohl has been appointed Superintendent, in place of J. R. Hardy, resigned.

Kansas & Gulf Short Line.—W. P. Homan has been appointed General Manager.

Louisville & Nashville.—Harvey Middleton has been appointed Superintendent of Machinery in place of Reuben Wells retired from the service. The office of Assistant Superintendent of Machinery has been abolished.

New York, Rutland & Montreal.—C. H. Rogers has resigned as Purchasing Agent.

New York, New Haven & Hartford.—W. E. Chamberlain has been appointed Superintendent of the Harlem River Branch; E. G. Allen has been appointed Superintendent of Shore Line Division; and W. H. Turner Superintendent of the New York Division.

New York, Rutland & Montreal.—C. E. White, having resigned as General Manager, the duties of the position will hereafter devolve on J. P. Hopson, Superintendent.

New York & New England.—A. A. Jackson has been appointed General Superintendent, and R. E. Evanson Superintendent of Eastern Division.

Northern Pacific.—Wm. Moir has been appointed Master Mechanic of the Idaho Division, in place of John Evans, who has been appointed Assistant Superintendent of Machinery of the Western Divisions. N. D. Root has been appointed Superintendent of the Montana Division, in place of F. L. Richmond resigned.

Owensborough & Nashville.—E. H. Mann has been appointed Superintendent, vice W. M. Newbold assigned to other duties.

Rome, Watertown & Ogdensburg.—E. A. Van Horne, General Superintendent of the Eastern Division, has resigned.

Union Pacific.—S. R. Callaway has resigned his position as General Manager.

Employment.

MANAGER WANTED.—An active, brainy man, fully posted in Car Wheel and General Foundry Work, with capacity to successfully operate a large establishment in the Southwest, and who can give the best references. Address "Car Wheel," office of NATIONAL CAR AND LOCOMOTIVE BUILDER. 2t